

SUPPLEMENT

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THE TECHNIQUE OF X-RAY EXAMINATION OF THE CHEST.

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At the Brisbane General Hospital there is no resident radiologist and only the most necessary screen work is done, with the result that in chest cases there is no routine preliminary screening, but films are the first step in chest examinations. If, after the films are taken, a definite opinion cannot be given and it seems that a screening would help, then one is carried out.

In my private work every patient sent for a chest examination has a preliminary screen examination.

Every patient with a few exceptions wears a buttonless gown. He is first placed in the upright position with his back to the tube and facing the screen. The apices are first examined for any change in translucency. At the same time the upper part of the aortic arch is examined for evidence of any abnormality in this vessel.

The space between the upper part of the aorta and the lowest part of the neck often gives information which is of use, such as, the presence of an intrathoracic thyroid gland or other tumour. These intrathoracic thyroid glands are not very uncommon.

Next, the heart shadows and hilar shadows are noted. Then the main mass of the lungs is examined. Finally, both domes of the diaphragm are examined, while the patient is instructed to breathe deeply and any abnormality in the movement or outline of the diaphragm is noted. The costo-phrenic angle is inspected for the presence of fluid or adhesions.

The patient is now rotated, first into the right anterior oblique and then into the left anterior oblique positions in order to get a view of the space between the aorta and the vertebral column and to throw the shadow of the aortic arch clear of the spine. In these semi-lateral positions enlargements of deep glands or abnormalities of the aortic arch may be seen, which are often not visible in the straight transverse views.

I do not make it a fixed rule to examine the patient with the screen behind and the tube in front unless the first views point to the advisability of doing so.

It is neither necessary nor advisable to expose the

patient to a long screen examination, as the coarser lung features alone are visible on the screen. This preliminary examination only takes a short time if the operator goes through a regular routine of the examination of the points just mentioned.

Finally, the patient is placed on the table and a couple of films are taken by one of the two following methods, providing he is in moderately good physical condition. The first is the long distance method. During the last eight to twelve months we have been doing without the diaphragm, and using a medium focus Coolidge tube and about a 152 centimetre (60 inch) target plate distance, drawing about one hundred *milliampères* for a fraction of a second or for as long as is necessary, even up to about one second for very thick chests. The tubes seem to stand up to this comparatively long exposure quite well, provided too high a spark gap is not used and we find that with soft tubes better results are obtained. Even in thick subjects it is better to increase the exposure rather than to use a hard tube.

A small cylinder or cone is used and at these long distances it does not take a very large cone to cover the whole lung field and in addition the use of the small cone very considerably sharpens the detail.

The second method is with the Potter-Bucky diaphragm. With this method the patient is placed face downwards and a fine focus Coolidge or gas tube is used, drawing about thirty *milliampères* and at 10.4 centimetres to 14 centimetres ($4\frac{1}{2}$ inch to $5\frac{1}{2}$ inch) spark gap.

The patient is instructed to hold his breath and an exposure of from two to three seconds approximately is given, according to the thickness of the patient.

I have almost given up the use of stereoscopic views of the chest as a routine, although two views are always taken, the tube being shifted towards the feet of the patient about the usual distance used in stereoscopic work. I find that if required these views can be used in the stereoscope, if they are viewed with the film placed laterally in the viewing box.

During the last eight to twelve months the Potter-Bucky diaphragm has been largely superseded by the long distance method.

Both methods have advantages and disadvantages.

With the Potter-Bucky diaphragm the contrasts are better, but the details are not as sharp, except when a gas tube is used. The exposures are necessarily longer and there is more risk of the picture being spoilt by respiratory movements.

It does not greatly matter how much you instruct patients how to hold their breath. There are always some who have not enough common sense to do so.

I am not referring to those patients who are physically unable to hold their breath, as they are always examined with the long distance method, because of the shorter exposures that can be used. The photographs generally are sharper with this, the long distance method; but it is more severe on the tubes, owing to the higher *milliampère* necessary. A gas tube cannot be used for the same reason.

In both methods the patients are placed face downwards unless there is difficulty in respiration. In these cases some more comfortable position has to be adopted and the method varied accordingly. For this latter class of patient, that is, for those who are very ill, screening is done with the tube below the table. Then a film is placed on the patient's chest and a picture taken.

Finally, then, a summary of my opinion of our two chief methods is as follows:

For long distance methods the advantages are the shorter exposure, the sharper detail and the smaller amount of distortion. The disadvantages are the shorter life of the tubes, the diminished contrast and the possible difficulty in getting the necessary distance from the tube.

When using Potter-Bucky diaphragm the advantages noticed are that a gas tube can be used, if desired, and fine detail sharpened. The smaller *milliampère* is less destructive to the tubes and the contrasts are better. The disadvantages are that there is more distortion and tendency to get respirations.

THE TECHNIQUE OF X-RAY EXAMINATION OF THE GALL-BLADDER.

By J. G. EDWARDS, M.B., M.S.,

Honorary Radiologist to the Sydney Hospital.

WE must confess that we are disappointed in the results of gall bladder examinations as far as the actual demonstration of calculi is concerned and consider that we get far greater information as to the gall bladder condition from the opaque meal examination.

In regard to straight-out radiography of the gall-bladder region we find it easier to demonstrate the pathological gall-bladder than the gall-stones.

We follow the technique advised by George and Leonard except that we employ the Potter-Bucky diaphragm.

Two or more antero-posterior and two or more postero-anterior films are used with the usual double intensifying screens at sixty-three centimetres distance. We employ twenty *milliampères* of current for five seconds at varying kilovoltages for the various exposures and develop all the films for the same time at the same temperature. In this way we get variously exposed negatives and can frequently demonstrate the gall-bladder. Confusion in interpretation occurs from overlapping of the kidney, liver and gall-bladder shadows and one must be very careful in interpreting this most difficult type of skiagram.

Whatever result we obtain from direct examination, we proceed to an opaque meal examination.

We use the barium sulphate suspension in mucilage and

it is frequently possible to demonstrate pressure from the gall-bladder on the pyloric antrum and duodenum and also to demonstrate fixation of the pyloro-duodenal segment or of the hepatic flexure of the colon by adhesions.

In addition we get signs of duodenal irritability and gastric hypermotility with occasional very misleading deformity of the duodenal cap. On many occasions we have reported this deformity of the cap as being due to ulcer, but at operation it has been found that gall-stones were present.

On one occasion we reported shadows in the right loin as being due to renal calculus, but no calculus was found at a nephrotomy and the surgeon on exploring the abdomen found gall-stones.

Another confusing shadow is that cast by calcified costal cartilages. With ordinary care such calcified areas should not be interpreted as gall-stones. Faecal collections in the hepatic flexure give confusing appearances. These collections will even remain after purgation.

Enemata should be combined with the usual castor oil aperient in these constipated subjects.

DR. C. E. DENNIS said that he considered toxic adenomata as purely surgical conditions, not to be treated by irradiation. In exophthalmic goitre the results of radiotherapy were as a rule excellent, but he thought that if no improvement was apparent after a month or six weeks of treatment, the patient should be referred to a surgeon for consultation. Such consultation should be sought before there had been sufficient radiation to induce fibrosis. The patients in whom the best response was seen, were those with large, soft, pulsating thyroid glands; they showed the typical rapid pulse, exophthalmos and tremor and complained of nervousness, excessive perspiration, palpitation and weakness. When improvement began, the patient reported amelioration of the symptoms in the order named, the slowing of the pulse, diminution in tremor and exophthalmos taking longest to disappear.

Some of the clinically worst types had shown the most rapid response. One patient particularly, half of whose thyroid had been removed and who had relapsed into a condition worse than that before operation, did remarkably well under X-ray therapy. It was necessary to attend to general treatment such as complete rest and liberal diet, although some mildly affected patients had improved under irradiation while continuing their duties.

He used a three to four millimetre aluminium filter and in no case had he ever induced any erythema or had any ill results. A one-fourth erythema dose was given to each side of the gland once a week. He wished to present radio-therapy not as a rival, but as a companion to surgery.

DR. L. J. CLENDINNEN said that his views generally were in accord with those embodied in Dr. Edwards' paper. Opportunity for the X-ray treatment of exophthalmic goitre did not arise very frequently in Melbourne. In recent years the technique had been practically standardized. The basal metabolic test had proved an extremely useful control in treatment: on the average a 20% drop was found to have occurred when the basal metabolism was estimated three weeks after one treatment. He considered that if there was not a decided fall in the basal metabolic rate, the patient should be referred to a surgeon. The length of time necessary was a factor to the disadvantage of X-ray therapy in exophthalmic goitre: probably the best method was represented by a combina-

tion of radio-therapy and surgery. A dose of X-ray treatment followed by rest in bed for three weeks would make a one-stage operation possible and reduce the operative risk. The fibrosis referred to by Dr. Dennis was one result of prolonged X-ray therapy, but it was not found in patients who had received their treatment within six months. With the improved technique which they could anticipate for the future and this included treatment under metabolic rate control, myxoedema should be unknown.

DR. H. FLECKER quoted Pfahler as having treated approximately two hundred individuals affected with exophthalmic goitre by X-rays. Three patients only had been operated upon and Pfahler did not admit the necessity for these; there had been only two deaths and one instance of recurrence in the whole series; all were said to have been inoperable.

The advantages of irradiation in the treatment of exophthalmic goitre were (i.) freedom from danger; there was no mortality, (ii.) ease of application and minimum inconvenience and loss of time to the patient, (iii.) it was available in inoperable and post-operative (recurrent) cases. Other speakers had emphasized that general management was important and irradiation should not be prolonged beyond a few months. Burrows and Morrison had reported the results in a series of one hundred consecutive cases of exophthalmic goitre treated by X-rays and by radium and had classified them.

Perfect results with a complete disappearance of symptoms had been obtained in twenty-seven patients treated with X-rays and twenty treated with radium. Good functional results had been obtained after the X-ray treatment in forty-nine patients and after radium therapy in twenty-five. These patients had been enabled to lead ordinary but not arduous lives. Twenty patients treated with X-rays and forty treated with radium had been improved, while four patients treated with X-rays and twenty treated with radium had not improved.

It had been objected against radio-therapy that it rendered subsequent surgical measures more difficult on account of the presence of adhesions between the muscles and the capsule of the thyroid. Evidence existed to show that the operative conditions were easier after irradiation because of the greater vascularity of the tissues. The possibility of hypo-thyroidism had also been urged as an objection to X-ray therapy.

DR. J. G. EDWARDS said that for radiographic examination of the chest he employed an exposure of one-twelfth of a second at one hundred centimetres (forty inches) with one hundred milliamperes of current and a twelve and a half centimetre spark gap. Screen examinations were used only for observing diaphragm movements and for squaring the patient. Postero-anterior plates were employed as a routine and occasionally an antero-posterior photograph was taken. For this purpose the patient was asked to stand and the scapula was displaced outwards. Adhesion and fixation of the diaphragm might be demonstrated on films. Screen methods were adopted for the examination of the heart and great vessels.

DR. H. CARSWORTHY said that he was in agreement with the President in the views he had expressed regarding the disadvantages attaching to the Potter-Bucky diaphragm in thoracic radiography. He considered that the longer exposures required allowed involuntary and respiratory movement greater opportunities for spoiling the film. There was further no necessity in chest work to strive for the increase of contrast given by the Potter-Bucky diaphragm. It would always be difficult to carry

out the same technique in hospital as in private practice. In hospital work there was very little time to devote to screen work, but in private practice he made screen examination a routine. Much valuable information not provided by the film was to be obtained by screen examination which disclosed points relating to relative diminution of diaphragmatic movement on one side, the movements of the chambers of the heart *et cetera*.

He invariably took stereoscopic photographs in private practice and found them indispensable for interpretation as to size and position of pathological changes. He preferred radiography in the upright position, as a result of the flattening of the chest there was some distortion of the shadows in the horizontal position.

DR. HERBERT M. HEWLETT said that for a long period he used an ordinary double intensified film with an exposure of one-tenth of a second at a distance of seventy-five centimetres (thirty inches), and one hundred milliamperes of current and a seven and a half centimetre gap. For the last two years he had employed the Potter-Bucky diaphragm and recently had been working with postero-anterior views of the patient in the erect position. He was then using ten milliamperes of current at a distance of about eighty-five centimetres; the time of exposure was two to three seconds and the spark gap thirteen and three-quarter centimetres.

DR. C. E. DENNIS expressed himself as in agreement with the previous speakers regarding the disadvantages of the Potter-Bucky diaphragm in the radiography of the chest and said that he did not use it for this purpose.

He adopted the horizontal position with the patient face down and the tube at a distance of eighty-eight centimetres. In very nervous or tremulous patients he occasionally used a twenty centimetre spark gap and an exposure of one-fifth of a second. This gave a grey plate, but the detail was very sharp. A longer tube to plate distance would cause less distortion, but at eighty-eight centimetres the degree of distortion was negligible.

For cardiac skiagraphy he required the patient to be in the upright position.

DR. K. STUART CROSS said that his method included the use of the Potter-Bucky diaphragm and the erect posture in the patient. He considered that Dr. Hewlett's long experience in technique and his adherence to the Potter-Bucky diaphragm was significant of the superiority of this method. No doubt each radiographer perfected his own particular method of working.

DR. HOWARD F. PRAAGST advocated the use of stereoscopic films as undoubtedly superior to flat films. It was the practice at the Melbourne Hospital to make a preliminary screen examination. The spark gap was varied according to the size of the patient and the distance generally was about one hundred centimetres.

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ALTHOUGH in gall bladder radiography it is the exception rather than the rule to be able to demonstrate a well defined and definite stone shadow, yet the difficulties encountered should act rather as an incentive to us to improve our methods and ultimately to enable us to find some means by which it will one day be possible for us to demonstrate gall stone shadows with absolute certainty.

Only a small percentage of gall stones contain enough calcium salts to throw easily definable shadows.

In my work, I cannot claim anything like the percentage of positive results which I have often seen quoted, possibly because of my own failings in many instances.

I will now give a brief outline of my methods, in the hope that with your criticism and help I may be more successful in the future.

With practically all patients who are sent for gall bladder examination, I start by taking at least two films of the gall bladder area and then a routine opaque meal examination follows.

The first two films are the ordinary duplitized films with double screens. The patient is placed face downwards with the usual gall bladder locality in the centre of the Potter-Bucky diaphragm. A fine focus Coolidge tube is used at thirty *milliampères* with a twelve and a half to fifteen centimetre (five to six inch) gap, according to the size of patient and seven to ten seconds' exposure. The patient is tilted a little to the right side and the body is bent slightly, so as to give as wide a gap as possible between the last rib and the crest of the right ilium. The tube is centred midway between the last rib and the crest of the ilium about five centimetres (two inches) to the right of the middle line. The patient is instructed to hold his breath and is usually given a couple of trials to see that he understands what is required of him.

In some cases it is impossible for the patients to hold their breath. They either do not understand what is required or they cannot do it. These patients are not very numerous if one gives them a preliminary trial or two at holding their breath, but they are encountered and then it is necessary to alter my methods.

For this latter type of patient I use a soft tube and a very short exposure through a small aperture with one hundred *milliampères* and at ninety centimetres (thirty-six inches) distance. This latter method does not give the same contrasts, but still a sharp picture is obtained. Unless the resulting picture is a sharp one, it is useless for gall bladder work and it should be taken again.

Another detail which is often overlooked and which makes quite a difference to results, is the freshness of the developing solution. A developer which may be quite fresh enough to give apparently first class results in bone and bismuth meal work, is often quite useless for gall stone pictures. The correct temperature of the solution is, of course, a well recognized factor in giving the film the correct density. If the temperature of the developer is too warm, a dull foggy negative is the result. In Queensland the correct temperature of the solution can only be obtained by the plentiful use of ice in the warm half of the year.

At one time I was much troubled by the presence of finger prints on the films, although they were never touched with the hands from the time they were taken out of the original packet until they were fixed, but were always handled with forceps. I came to the conclusion that the finger prints were present from the time that the films were packed. A suitable acid fixing and hardening bath removed this source of annoyance.

In spite of every effort it is only in a small percentage of cases that I have succeeded in obtaining unmistakable gall

stone shadows. The shadow of a distended or abnormal gall bladder is rather more frequently seen; indefinite shadows are still more frequently seen. If one were to consider all of these as positive, I have no doubt that then a very high percentage of positive results could be claimed; but I do not consider this to be a fair claim.

The opaque meal following the routine gall bladder procedure often reveals information about the right upper quadrant which would otherwise be missed. For example, pressure signs on the duodenal cap or pyloric end of the stomach are often seen and when these correspond in outline and position to what one would expect from a distended gall bladder, a diagnosis is made to that effect. Again, instead of evidence of distension of the gall bladder, one can in some cases find evidence of adhesions in the region of the duodenal cap, pylorus or hepatic flexure. What I regard as an almost certain sign of adhesions in the region of the duodenum is the presence of one or more small, sharp indentations into the shadow of the *caput duodenalis*. When any one of these conditions is present, the only difficulty is to determine whether these changes from the normal are or are not due to an intrinsic lesion of the duodenum or pylorus; the behaviour of the opaque meal during the course of the examination often enables one to settle this point. Without the assistance of the opaque meal, many of these indirect signs would otherwise be missed.

RADIOGRAPHY OF THE CRANIUM.

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In preventive medicine, the prevailing spirit of this Congress, it is difficult to find a place for a paper on the radiography of the cranium, unless it be considered as an effort to prevent patients going to the operation or *post mortem* room before a thorough X-ray examination has been carried out!

The surgery of the brain must always be difficult and often disappointing on account of the vital structures concerned, difficulty of approach and the infiltrating character of many of the lesions; on the other hand, not a few lesions are accessible and removable if their presence could be diagnosed and their position localized a little earlier. This has been the great difficulty in the past and it is in the elucidation of these points that X-rays should be of assistance. I do not say "is," but "should be." For I feel that in comparison with other branches of the subject, cranial radiography has been somewhat neglected. Yet we are considering a part of the body eminently suitable for radiographic investigation, a structure not directly affected by respiratory or other involuntary muscular movements, a part that can be radiographed in innumerable positions, the walls of which lend themselves admirably to stereoscopy and are often profoundly modified by intra-cranial pathology. The one baffling circumstance is the homogeneity of the shadow cast by the soft tissues inside. Will this always remain an insurmountable barrier to X-ray interpretation? Personally, I am optimistic enough to hope that ways and means will be discovered of getting round this difficulty; and that signs,

probably staring us in the face as we study our films, will be revealed to us by patient research in collaboration with clinicians and pathologists. It is in this frame of mind that I welcome the opportunity to bring this branch of radiography before you; to review the position and if possible stimulate further concerted research in a branch that in results is lagging behind its fellows.

Technique.

I propose to deal as briefly as possible with the question of technique, merely making a few observations which to me seem pertinent.

First and foremost I consider stereoscopic representation to be absolutely indispensable; I cannot think of a solitary case in which the varying densities seen on a single film, are not greatly enhanced in clearness and meaning in the stereoscope, but I know of many instances in which the stereoscopic view has prevented an erroneous conception of affairs.

With regard to position, of course the standard positions should be used as a routine; a thorough knowledge of the normal appearances is essential before the abnormal can be detected and interpreted. The radiologist as well as the clinician who usually wants to see for himself also, has a better conception of the normal in standard positions. However, there are occasions where in addition to the usual positions freak views, if I may call them so, are of decided value. In this connexion I find it extremely helpful to have a set of radiograms of a dry skull taken in many oblique directions; by a previous study of these I can select the most suitable positions in which to radiograph to the best advantage any particular region. I utilize a dry skull for my key-plates because the minute anatomical features on the film can be very readily identified by comparison with the skull in question and the information so obtained applied to the radiograms of the head under examination.

There can be no question that the advent of the Potter-Bucky diaphragm has improved the technique of cranial radiography. Of course, its great advantage lies in enabling one to take entire views of the cranium without that distressing fog. However, the inherent disadvantage of increased distance between the object and the film, with the consequent loss of fine detail, is in many cases a drawback and for this reason I still prefer the small diaphragm view of special regions.

There is one technical method which must be mentioned, but about which I cannot talk with any personal experience, namely pneumo-craniography or pneumo-ventriculography. Apparently valuable information of brain pathology can be derived from this procedure which is at present unobtainable in any other way. However, it is an undertaking which cannot be devoid of risk, and certainly should be carried out by an expert and therefore cannot become routine except in special circumstances.

Interpretation.

Let us proceed to consider the question of interpretation. To begin with a thorough knowledge of the normal appearances is essential to the identification of the abnormal. This remark may seem superfluous, yet it is so very important that it cannot be reiterated too often; failure to appreciate this maxim is so frequently the

stumbling-block of what one might call the amateur radiologist.

Now the skull, like the nose, can vary very widely within normal limits and the variation from normal is often only a matter of degree, often more a question of experience than mathematics. The shape, size, thickness of walls, depth of convolutional depressions and closure of sutures vary with age, sex, race, mental development and so forth and it is by a consideration of these factors that we can attempt to separate the normal from the abnormal.

In the first place we note the general form and configuration of the cranial outline. In the main, this is only of anthropological interest, such, for example as the dolico-cephalic skull of Western European races and the brachy-cephalic skull of Eastern Europeans. But there are certain types which have a distinct clinical significance, such as the micro-cephalic skull found in some congenital idiots and epileptics either as cause or effect, the megaloccephalic skull of hydrocephalus, *osteitis deformans* and other diffuse hyperostoses, the turiccephalic skull due to premature obliteration of the sagittal suture, the plagiocephalic skull due to unilateral suture fusion and the various deformities secondary to rickets, spinal deformities, obstetrical injuries, nerve lesions *et cetera*.

The importance of a knowledge of these conditions may not be apparent until one remembers that many of these deformities may clinically simulate each other and, what is more important still, be mimicked by other morbid states of the brain, calvarium or scalp which it is sometimes difficult, if not impossible, to differentiate without the aid of X-rays. And it is for this that the radiologist lives.

Next one may consider the sutures. It is a point of some importance to have at least a working knowledge of the time of closure of the main sutures. From a radiographic standpoint the sutures of the base are unimportant as they close during intra-uterine or within the first few months of extra-uterine existence. There is one exception, the spheno-occipital synarthrosis which remains distinct until normal bone growth discontinues after puberty. Premature closure of this cartilaginous junction is responsible for the characteristic basal shortening and retraction of the nose of the achondroplastic skull; a similar deformity occurs in cretins from delayed occlusion, but at the same time tardy osteogenesis, a diagnostic point between the two conditions.

Contrasting with the basal sutures the synarthroses between the membranous bones of the cranium normally remain distinct for years after maturity, though the tendency is towards synostosis as age advances. In the ordinary course of events (remembering that the female is later than the male) synostosis begins in the sagittal suture posteriorly about the thirty-fifth year and in the coronal suture at the bregma about the forty-fifth year; the lambdoid suture is generally the last to ossify. Fusion is not normally complete until after the sixtieth year. The metopic suture bisecting the frontal bone is usually closed at the end of the second year, but may persist throughout life without pathological significance.

In addition to the occurrence of Wormian bones which may appear in any of the suture lines, most commonly at the points of intersection, cognizance should be taken

of the fact that certain rare sutures sometimes occur, dividing the normal bones and producing supernumerary ones. For example, the parietal bone may be divided partially or completely by a horizontal or a vertical suture-line; the *squama occipitalis* may be separated to form an independent bone, the *os interparietalis* or *os inca* which is in turn more rarely subdivided; and the squamous portion of the temporal bone may exist as a separate bone or be traversed vertically by one or more sutures. These are of more than morphological interest, as their unusual occurrence may bring about erroneous deductions in cases of head injury.

The most important diagnostic finding, however, is the widening of one or more suture-lines indicating separation of the bones and invariably due to an increase in the intra-cranial pressure. This is a most important finding, because it is just in these cases that other radiographic and clinical evidence of increased tension may be meagre, their advent being delayed by yielding of the joints of the normally rigid container. It frequently accompanies hydrocephalus of long-standing and its finding immediately excludes hydrocephalus secondary to cranio-stenosis.

In children a study of the fontanelles may disclose evidence of value. Normally the fontanelles are six in number, situated at the bregma and lambda in the centre line and at the asterion and pterion on either side. These membranous spaces become obliterated towards the end of the second year. However, they may persist for longer periods in certain general bone dystrophies, for example in achondroplasia and rickets.

One may now consider the thickness and density of the bony walls, due regard being paid to the question of age, sex and race.

The thickness of the cranial bones increases with age up to a certain point, until with old age the bones again become thinner and lighter. Then again the skull of a male is thick and has prominent bony ridges and depressions compared with that of the female; also the relative thickness of the skull of the negro or aborigine is notorious.

One should note if possible the relative thickness of the inner and outer table and the intervening diploe.

Instances of abnormal bony thinning are almost invariably brought about by chronically increased intra-cranial tension from whatever cause and may be manifested locally or generally. In advanced cases the picture is, of course, typical in the pressure-atrophy of the inner table and intensified convoluted depressions. However, in early cases it is a matter of great difficulty to decide just when these appearances become abnormal, especially as the convoluted depressions normally deepen with age and intellectual development.

Tumours and cysts of the brain and meninges may and often do in addition cause local bony erosion and thinning; but here again the appearances are often identical with those of the normally thin areas in the frontal, squamo-occipital and temporal regions and it remains for us to discover means to differentiate with more certainty between the two.

The subject of bony erosion in the cranium brings us to a consideration of the *sella turcica* and adjacent bony

prominences, as it is in this region that the most typical and unmistakable signs of bony destruction are to be found in certain cases. The delicate clinoid processes undergo pressure-atrophy early from any neoplastic process in the vicinity. Not only is it often possible from the X-ray evidence alone to give a definite diagnosis of cerebral new-growth, but often a very shrewd opinion as to the location and origin of the tumour can be made. For instance, an intra-sellar tumour produces the characteristic enlargement and deepening of the *sella* with thinning and backward bending of the *dorsum sellae*; a tumour at the entrance causes more flattening of the *sella* with erosion of both anterior and posterior clinoid processes; while a tumour in the region of the *pons*, for example auditory nerve tumour, produces thinning and forward bending of the *dorsum sellae*; new-growths on one or other side may produce unilateral erosion and so forth. The fact must not be overlooked that pathological processes in other localities can, by causing chronic intra-cranial hypertension, produce very similar atrophic changes in the hypophyseal region of the base and conversely tumours of the basal structures in time cause signs elsewhere of general hypertension. However, a distinction can often be made on the relative intensity of the local or general signs.

Also it is to be remembered that aneurysms of the basal arteries, cysts, granulomata and other conditions besides tumours can produce pressure changes in this as in other localities.

It is not possible in a compilation such as this to deal adequately with the many fine points of diagnosis in this region; but enough has been said I hope to refresh your memory and stimulate the search for yet finer and more significant details.

The next point to consider is that of bony hypertrophy and sclerosis.

The differentiation between bony overgrowth and bulging of thinned cranial walls from pressure is radiographically obvious and clinically important. In this respect it is to be remembered that subdural bony sclerosis sometimes occurs over a slow-growing cerebral tumour or chronic inflammatory process in the meninges, but there is no obvious expansion of the bone in such a case. Instances of bone expansion are often radiographically pathognomonic, as example, the diffuse "woolly" thickening of *osteitis deformans* and the irregular sub-periosteal nodular sclerosis of syphilis (not, of course, the only cranial manifestation of this disease).

Thickening of the outer table results from stimulation of the periosteum in certain chronic inflammations of the scalp; chronic osteomyelitis of the cranium causes sclerosis and thickening of the bone; expansion of the calvarium is found in myeloid sarcoma and so on. All these conditions have fairly characteristic appearances and the X-ray findings often prove a large factor in the diagnosis.

Osteomata may project into the cranial cavity and cause obscure cerebral symptoms. I have noted one such case originating at the base of the right anterior clinoid process.

It is convenient next to come to a study of the venous systems of the cranium, from which important conclusions can be drawn.

Usually only the grooves for the lateral and longitudinal sinuses are at all plainly visible on the film; but in certain pathological states other sinuses, notably the sphenoparietal sinus, may become enlarged and more or less evident. By a careful study of the sinuses involved it may be possible to locate points of obstruction to the venous flow on one or other side. For example, dilatation of the sphenoparietal sinus often follows compression of the cavernous sinus by a tumour in the middle fossa.

In intimate relationship with the intra-cranial venous canals are the diploic veins and these merit careful study. These veins form a more or less vertical plexus on each side with a main channel running longitudinally through the middle of the parietal bone connecting those in the frontal with those in the post-parietal and occipital regions. The shape and size of these venous channels are very variable; bends, constrictions and dilatations are the rule, which fact serves to distinguish them usually from fractures, sutures and the intra-cranial arterial and venous grooves.

However, in certain pathological states as a result of local or general intra-cranial pressure these veins and their emissaries show evidence of local or general dilatation indicative of the establishment of a collateral venous circulation secondary to chronic interference with the return of blood through one or more of the intra-cranial venous sinuses. This is exemplified by unilateral venous dilatation sometimes accompanying a unilateral hydrocephalic state due to an organic brain lesion, the latter being almost invariably on the same side.

In comparison with the venous system a study of the intra-cranial arterial system gives much less information as to the condition of affairs within the skull. It stands to reason that in all pathological states evidence of which is at all likely to be imprinted on an X-ray film, the relatively strong-walled arteries containing fluid under pressure will be much less affected than the thin-walled veins with their sluggish and easily impeded blood flow. However, the foramina of entrance of the arteries can be studied in appropriate positions and the main branches of the cortical blood vessels traced in their grooves on the inner table of the skull. Thus small aneurysms may be inferred and information made available to the surgeon as to the normality or otherwise of the main blood vessels in a proposed operative area.

It is appropriate here to mention that a warning to the surgeon of the situation of abnormally distended venous sinuses in the diploe may prevent annoying, if not serious, hæmorrhage at operation.

Lastly, abnormal calcareous deposits may occur in the brain or meninges. Unfortunately in the brain these are of rare occurrence found in various neoplasms, cyst-walls, scars and old hæmorrhages which then give valuable evidence of the presence of pathology and its location.

The pineal body can be identified as a more or less calcified mass in the centre of the cranial cavity in a fair proportion of cases and though of no pathological significance in itself may by its displacement to one side indicate the presence of a tumour or degenerative process in its neighbourhood. The same might conceivably apply to the small calcareous plaques rarely noted in the *falx cerebri*.

Conclusion.

In the preceding remarks I have endeavoured to outline the present position with regard to the X-ray diagnosis of cranial and intra-cranial pathology, hoping thereby to promote productive discussion and criticism.

In order to advance, the science of radiography must go hand in hand with that of pathology; for what are our abnormal shadows but those of pathological states hidden from the pathologist until section or autopsy?

Therefore the clear indication seems to me to be to interest the pathologist in X-ray interpretation, so that he may come to realize that a *post mortem* report on the secondary morbid changes in the cranium of at first sight no particular food-value may, predigested by the radiologist, prove to be an important addition to the clinician's diet. For how common it is to see the pathological brain and meninges undergo minute and careful scrutiny while their bony container, the radiologist's land of promise, receives scant attention.

The last chapters in the Book of Radiography have not yet been perused, the pages are being cut slowly and laboriously; but it is on such occasions as this that means are suggested of separating another page or two; and herein lies my object in presenting this subject for discussion.

DR. HERBERT M. HEWLETT asked if the patient in whom Dr. Nott had described an exostosis of the clinoid process had exhibited any symptoms attributable to pressure on the optic chiasma. Had Dr. Nott experienced difficulty in the diagnosis of fractures of the frontal bone?

Dr. Hewlett showed a film illustrating multiple psammomata in a boy ten years of age. This boy had been subject to epileptic seizures, but had been otherwise in good health; he had been trephined and the structureless mass removed had been pronounced a psammoma.

DR. C. E. DENNIS supported Dr. Nott in his advocacy of the more extended use of the X-rays in the detection of cranial abnormalities. To him it was a matter for surprise that a larger number of doubtful fractures of the skull were not submitted to the radiographer for examination. He showed a skiagram in which was seen a large area of calcification in the mid-line of the brain. The patient from whom the film was obtained, had undergone a decompression operation at the Melbourne Hospital thirteen years previously for cerebral tumour. After a protracted convalescence she had regained her health and had remained well for twelve years and only recently had again come under observation on account of the development of epileptiform seizures. The area of calcification appeared to be in the *corpus callosum*.

DR. K. STUART CROSS exhibited films illustrating (i.) unilateral hyperostosis of the sphenoid, (ii.) calcifications in the *falx cerebri* in association with Jacksonian epilepsy, (iii.) an abscess in the region of the *sella turcica*. This abscess had followed cellulitis of the scalp and had been accompanied by loss of vision in the left eye.

DR. NORR in reply said that the answer to Dr. Hewlett's question was in the negative; the patient had displayed no symptoms referable to pressure on the optic chiasma, but had suffered from nausea, vomiting, headache and transient losses of consciousness. These symptoms had been present for four months when the radiographic examination was made. The radiographic demonstration by Dr. Cross of pathological changes in the soft parts in a patient with an orbital cyst was matter for congratula-

tion in that it represented an advance in the technique of cranial radiography. He had been interested in the remarks of Dr. Clendinnen concerning the connexion between incipient epileptiform attacks and changes in the *sella turcica* and he agreed with him that this structure was liable to considerable variations within the normal. After all one of the great difficulties was to know the normal.

FURTHER EXPERIENCES IN DEEP X-RAY THERAPY.

By H. FLECKER, F.R.C.S.,

Honorary Radiologist, Austin Hospital, Melbourne.

Disparaging criticism is frequently hurled at this method of treatment by radiologists and others who appear to be unprovided with apparatus of the requisite efficiency or if so provided, have not followed the principles, especially those applying to dosage, which are absolutely essential for any degree of success. Naturally when the cooperation of the physieist, clinician, surgeon and pathologist is available, much better results are obtainable than when the radiologist is left to his own unaided resources.

Wintz and Seitz appear to be responsible for the idea of a definite dose required for carcinoma, sarcoma *et cetera*, so that the impression prevailing was that a fixed dosage of irradiation would for instance suffice to arrest



Figure I., Epitheliomata of the Forearm.



Figure II., Epitheliomata of the Forearm.

the growth of a carcinoma. This is, unfortunately, far from being the case in actual practice, for while a given amount of radiation may perhaps arrest the metastatic carcinomatous growth in the spine, it would have an inappreciable effect upon carcinoma of the tongue. The resistance of the patient must likewise be taken into account and is of considerable importance. The appended illustrations are, I believe, unique and demonstrate conclusively that even in the same subject, where the general resistance is presumably the same towards each tumour, different tumours present different sensitivities towards irradiation. The subject of these pictures is a decrepit old woman aged eighty-four years from the Austin Hospital who had two different (apparently both primary) epitheliomata upon the forearm. The ulcerating growth responded very well, although its fungating neighbour failed to do so. Both growths were treated simultaneously through the same portal and therefore received exactly the same dose (see Figures I. and II.).

Nor is it sufficient in lesions of any depth to rely merely upon an erythema dose to one or more areas of the skin. Every part of the malignant growth, visible or invisible, must receive an adequate dose *in situ*, that is wherever the growth happens to be situated and this can only be done

by careful calculations which should be specially carried out for each patient treated. Although the readiest and simplest calculations are made by the aid of Dessauer's charts, other methods are available. As too great a dosage is likely to do harm to the neighbouring normal deep structures as well as to the skin, great care is necessary, for even with an intact skin, a patient may receive serious X-ray injuries at a depth. If the patient is unable to stand a full dose, it is useless to attempt treatment, but in actual practice it is found that there are very few patients unable to stand the effects of such dosage. It cannot be too strongly emphasized that without sufficient voltage it is impossible to produce rays of sufficient penetration to secure an adequate dose to deeply seated tumours without serious damage to overlying normal structures, particularly the skin.

The responsibility attaching to the radiologist is similar to that of the surgeon, so that it is just as unreasonable to trust the treatment of any particular lesion to a technician as to allow a layman to perform an operation. With efficient apparatus all factors essential for estimating the dosage, such as voltage, milliamperage *et cetera* are under perfect control, so that the requisite dose becomes a matter of careful calculation. There should be no excuse for guesswork. The more generally this principle is recognized and applied, the less one hears of special idiosyncrasies to X-ray "burns." A radiologist has no more right to demand an indemnity from his patient to refrain from taking legal action in case of "burns" or similar accidents than a surgeon would have in case of disasters which may result from his operations. Much discredit has been attached to this form of treatment owing to the occurrence of "burns" from time to time which with our improved control over dosage should not occur.

The pictures reproduced with the account of my demonstrations illustrate a rodent ulcer which had been treated and already described by myself. This case shows the immense superiority in result obtainable as compared with other means, such as excision, diathermy or even radium. The patient is free from recurrence eleven months since the last treatment. Molesworth and Harrison report similar results. Unfortunately ulcers which have had prolonged treatment previously with radium, X-rays of longer wave length or diathermy, do not appear to respond so well to intensive X-radiation because the tissues are so devitalized by these processes. Although it will probably be classed as a procedure similar to the squashing of a beetle with a sledge hammer, I feel sure that even small rodent ulcers are best treated by means of intensive X-rays. In view of the frequency which one sees recurrences in cases treated by all other means, and in view of the lessened vitality of the tissues after such treatments, it is surely in the interests of the patient that the lesion, however insignificant in appearance, should be cleared up absolutely as the result of the very first exposure; this can only be guaranteed by the employment of rays of sufficient intensity and penetration.

It is a common belief that deep radio-therapists are hostile to surgical procedures. Such, however, is far from the truth, as the active cooperation of the surgeon is usually sought. It cannot be too strongly urged that under certain circumstances, such as sarcomata occurring

upon the extremities, at least an opportunity should be given to the radiologist to clear up the lesion before having recourse to amputation. In radio-sensitive growths, the effect is extraordinarily rapid as occurred in the sarcoma of the humerus treated well over a year ago and already described by myself. The Registry of Bone Sarcomas which has been formed at the Harvard Medical School to which a section of the tumour was sent, has classed the lesion as "Ewing's endothelioma." The patient is still alive without any sign of recurrence and is very well. Codman, who has been making an extensive study of bone sarcomata, reported that of forty-one patients with undoubted osteogenic sarcoma only four were found living over five years and in every case the lesion had been treated by amputation alone. Of these Bloodgood reports that one has since died of metastasis and two have been retracted owing to mistaken diagnosis, so that cure even by amputation must be extremely rare.

The choice of anaesthetics in patients suffering from malignant disease may be of considerable importance judging by experiments which have been reported by Gaylord and Simpson. It has been shown in mice which have been subjected to either a repeated moderate loss of blood or to anaesthesia with either chloroform or ether (the effect of the former being worse) that inoculation with cancer substance from another mouse was almost invariably followed by tumour formation, whilst the control mice, not so treated, although similarly inoculated developed tumours in only about half the cases. This is believed to be due to the solvent action upon lipoids of these anaesthetics. It is accordingly suggested by Gaylord that where operative procedures are required, these should be carried out with gas-oxygen or local anaesthesia.

With regard to the nausea and vomiting which are such a distressing feature of prolonged treatment, I have tried as recommended elsewhere the administration of chlorotone (0.3 gramme) and "Uzara" but without any marked success. I am indebted to Dr. J. F. Wilkinson for his suggestion of "Validol" which is a valerianate of menthol. This when given in two gelatine capsules of 0.3 cubic centimetres each immediately before treatment has almost invariably inhibited these distressing symptoms at least during the period of treatment.

For building up the surface of the part treated in connexion with the employment of Dessauer's chart, I have until recently employed a mixture of wax and paraffin. Lately I have designed a device consisting of a rubber bag to be filled with warm water, with an upper surface affixed to a sheet of aluminum one millimetre thick, replacing the aluminum of the filter. The rubber is of the same quality as used in the compression bladder employed in diagnostic work. The water has approximately the same coefficient of absorption as the tissues themselves. The whole is kept in place by means of a compression band. The arrangement has been made for me by Watson and Sons, Limited, and it has many advantages over the older system.

With regard to breast carcinomata my experiences are most varied. Although experiments seem to indicate that it is the cells showing most rapid karyokinetic changes which are particularly susceptible to irradiation, yet the breast carcinomata which have responded best appear to

be the most chronic, as seen in the case illustrated and already described. Although never operated upon, the patient has remained clinically free from any recurrence eleven months after cessation of X-ray treatment.

To those who are sceptical about the value of post-operative irradiation in breast carcinomata, the observations of Lee at the New York Hospital are very interesting. The average length of life in a series of twenty-two patients upon whom a radical amputation with no subsequent irradiation was performed, was six and a half months after recurrence. Of one hundred and twenty-four patients treated by irradiation following the appearance of a recurrence, the average length of life has been two years and four months, a decided advantage in favour of irradiation.

Although it can be said that X-ray treatment of many carcinomata of the breast is very disappointing, still those with spinal metastases do not appear to be quite hopeless. Besides the one I have already described who is still alive and is possibly free from malignant growth almost twelve months after the treatment has been stopped, even more striking improvement has followed treatment of two similar cases.

Mrs. J.S., age forty-seven years, was sent by Dr. Frank Nyulasy who reported that her right breast had been removed by another surgeon on October 18, 1922. When he had first seen her on March 14, 1923, that is about five months after operation, she had been given up for some time as hopeless and was suffering from severe pain in the back, especially in the lumbar region with extreme tenderness on pressure over the lumbar spines, causing her to call out when touched. This pain had commenced about a month after operation and had been growing worse in spite of drug treatment. The patellar reflex was greatly exaggerated on the left side and abolished on the right. Some slight dribbling of urine was present. There was also pain in the lower cervical vertebrae and stiffness of the neck with pain and tingling of the fingers of the right hand and decided loss of power in gripping and raising the arm. The patient could be raised into a sitting posture in bed or turned to one side only with the greatest difficulty and the effort greatly aggravated the pain in the back.

X-ray examination revealed considerable involvement of the bodies of the lumbar vertebrae.

The first dose was applied to her lumbar spine on March 21, 1923. Within a few weeks her pain was very much relieved. By May 7 when she had her second dose, she was able to sit up and turn in bed. By July 5 she was able to walk from one room to another. On September 5 she was able to walk up and down steps unaided!

DEMONSTRATIONS.

Dr. H. Flecker exhibited patients at a special demonstration. These patients had been treated by means of deep X-ray therapy. He read the following notes.

Case I.—Tumour of Humerus.

Mrs. S., age thirty-eight, sent by Mr. H. B. Devine with an extensive brawny induration of the left arm and shoulder extending from below the elbow to the chest and root of the neck, which had been coming on gradually for the past six months, accompanied by a great deal of pain. No history of trauma was obtainable, although the swelling was preceded by pain lasting eighteen months and had been diagnosed as neuritis. Both the elbow and

shoulder joints were fixed and rigid and the whole limb thereby rendered useless. A skiagram is shown taken before treatment.

Report on histological tissue taken from the region of the deltoid muscle made by Dr. Brennan reads: "Fibrous reticulum with numbers of small spindle and round cells strongly suggestive of sarcoma." A section submitted to the Registry of Bone Sarcomas in Boston, United States of America, classified the lesion as "Ewing's endothelioma."

On July 27, 1922, a single intensive dose of X-radiation was given, a voltage of 200,000 being employed. Eight days later she was much excited at the improvement. By August 10 the swelling had almost disappeared and the pain and stiffness had so lessened that she was able to do up her hair. By September 8 she had gained five kilograms in weight. On November 17 she was able to play the piano.

During the year that has since elapsed, she has been able to carry out her domestic duties *et cetera* as though she had no disability whatever. Only two doses were given in all, the second as a precautionary measure on September 13, 1922, that is fourteen months ago.

Skiagrams taken prior to treatment and on October 2, 1923, were exhibited.

Case II.—Rodent Ulcer.

This patient was exhibited because of the hitherto accepted teaching that rodent ulcer attacking cartilage or bone was uninfluenced by radium and X-rays.

The patient was seen by both Dr. Herman Lawrence and Dr. W. Kent Hughes who do not doubt that the condition was of the nature of rodent ulcer.

Figures I., II., III. and IV. are from photographs taken before and after treatment at six monthly intervals.

C.C., aged sixty-five, an inmate of the Austin Hospital as the result of rodent ulcer, has lost the whole of the projecting part of his nose with the disease involving the eyelids on both sides and extending on to the face. The condition has been present for about twenty years. As the result of exposures on July 20, September 8 and December 12, 1922, the disease has entirely healed and an artificial nose provided, which greatly improves his cosmetic appearance.

Diathermy was inadmissible, owing to the proximity of the eye, whilst a cure by surgical means would have meant the sacrifice of both eyeballs. X-ray therapy has the advantage of avoiding the sacrifice of any healthy tissue.

Pain was absent throughout.

Case III.—Lymphoma of Pharynx.

W.H., age forty-seven, originally sent to the Austin Hospital by Dr. G. A. D. McArthur, complained on March 16, 1920, of difficulty in swallowing for several months. On each lateral wall of the pharynx immediately behind the posterior pillars were two tumours about the size of an almond shell, each covered by mucous membrane, the margins being sharply defined.

On October 15, 1920, the tumours burst through the mucous membrane at their upper poles and extended upward into the naso-pharynx, covering the mouths of the Eustachian tubes. The patient was very deaf, the raised voice being heard at fifteen cubic centimetres. A section of the tumour was made and a diagnosis of lymphoma made.

On October 26, 1920, the tumour on the left side was removed with restoration of hearing in the left ear.

On April 29, 1921, the deafness recurred in the left ear. The naso-pharynx appeared to be filled with growth, apparently from the tumour of the right side.

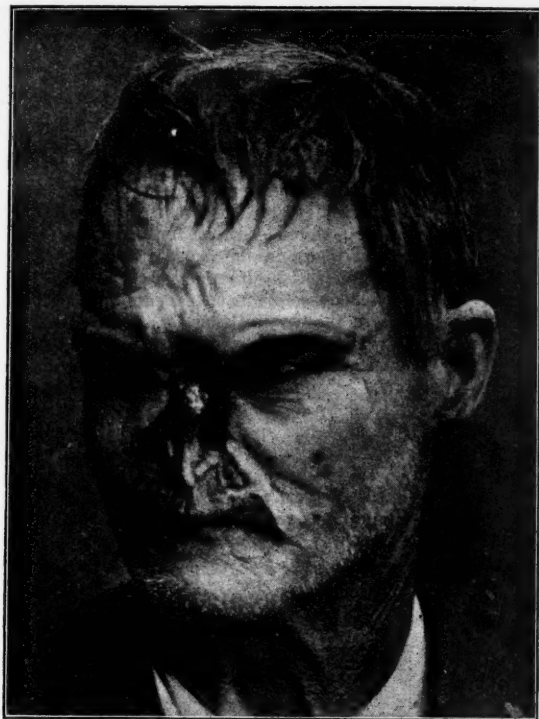


Figure I., Rodent Ulcer, Before Treatment.



Figure II., Same Patient, Six Months after First Treatment.



Figure III., Same Patient, One Year after First Treatment.

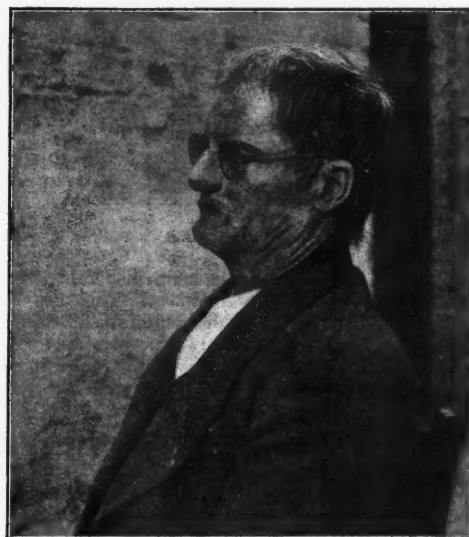


Figure IV., Same Patient, after Complete Healing, with Artificial Nose.

On June 7, 1921, the cervical glands on the left side were found to be enlarged.

Subsequently the glands of both sides of the neck as well as those under the mandible enlarged enormously, giving the patient a very peculiar appearance. The patient complained of difficulty of swallowing, deafness and a discharge from the nose and was particularly uncomfortable from the choking sensation produced by the large masses. As his condition was regarded hopeless, he was admitted to the Austin Hospital for Incurables.

As the result of a single exposure, given on September 7, 1922, the great bulk of the tumour disappeared within a fortnight and did not recur for about twelve days. Diminution in size of the tumour was noticeable in two days. The masses in the neck were scarcely palpable, hearing was restored, the pharynx was practically clear and there was no discharge from the nose. A second dose was applied on October 10, 1923. An acute abscess developed, which was opened and drained.*

Case IV.—Carcinoma of Breast, Inoperable.

Figures V. and VI. are reproduced from photographs taken before and after treatment at intervals of three months.



Figure V., Carcinoma of Breast, Before Treatment.

Miss S.C., age forty-two, had a lump in her breast for two years before deep X-ray treatment. This has been under X-ray treatment with a smaller outfit since December, 1921, since when she has had weekly exposures up to September 21, 1922. Although the growth was quite inoperable, this appeared to be sufficient to prevent the condition spreading.

Dr. Brennan's report of a section of the growth reads, "*Carcinoma simplex, tending to scirrhus type.*"

Two doses of deep X-radiation have been given in all, namely on November 6, and December 18, 1922 (see Figures V. and VI.).

* This abscess has since healed. When the patient was seen on May 8, 1924, there was no trace of any recurrence.

Case V.—Increased Intracranial Pressure.

Notes by Dr. J. Ramsay Webb, March 4, 1922. The patient was referred by Dr. Rosenfield who discovered double optic neuritis about a month ago (February 6, 1922). Six or seven months ago he began to retch and vomit first thing in the morning. He says that he has not had more than half a dozen breakfasts in that time, very rarely has he vomited at other times. Three or four months ago he had pains in the head, first in the frontal region and later at the occipital region almost to the neck. Now the headaches are not so severe and perhaps a little more often in the frontal than in the occipital area; they appear always in the morning and nearly every morning. They last only five or ten minutes or may last until dinner time. About six weeks ago he noticed failure of eyesight. He noticed when ploughing that the heads of the horses and landscapes became misty and after stopping for a few minutes he would recover. About two months ago a friend in town asked if he was drunk. He developed a "stagger" and it was soon noticed that he had a tendency to go to the left. He has not lost weight. Giddiness was a very early symptom before the vomiting. It was noticed particularly when he bent his head backwards. He had never been ill before, except



Figure VI., Same Patient, Three Months after First Treatment.

for measles. His father was healthy; his mother had died of Bright's disease. Three brothers and sisters were alive and well.

The patient is healthy looking and well developed, but with somewhat worried look, as if he has headaches. He stands with his legs wide apart and has definite Rombergism. There is no rigidity of his head. On testing this he complained of headache in the frontal region lasting a few seconds only and he fell forwards almost into my arms. He has lateral nystagmus and a fine continuous tremor of the protruded tongue. There are no tremors when the hands are stretched forwards, but the limbs wave unsteadily. The superficial and tendon reflexes are normal. Gait: the left leg is abducted and stiff, moving in short circles to obviate his tendency to move to the left, over-correcting to the right.

First operation on March 31, 1922. Two large tre-

phine holes were made over the cerebellar fossæ; bone was clipped away both mesially and laterally as far as possible. The *dura* was healthy looking, but not pulsating. Shock was considerable.

Second operation on April 7, 1922. The *dura* was protruding into a bony aperture, not pulsating. Its tension was high. Removal of bone was completed by making one large aperture. The *dura* was reflected. There was a moderate escape of cerebro-spinal fluid. The appearance of the cerebellum was normal. An attempt to examine the right cerebello-pontine angle was not satisfactory. The right lobe was explored in three places with a needle without result. Palpation of the cerebellum gave negative results.

For a fortnight after the operation there was much tension of the flaps and cerebro-spinal fluid escaped in large quantities. A definite "hernia" appeared and healing was not complete until nearly two months after the operation. His headache and vomiting improved for a time but soon recurred and at the time of his discharge on July 10, 1922, were very troublesome. Owing to extreme muscular weakness no observation as to his gait was possible, but his nystagmus seemed to have improved slightly. He was thought to have a diffuse cerebellar glioma and the prognosis regarded as hopeless.

Extracts from notes of Dr. M. D. Silberberg, made prior to operation.

"Wassermann reaction negative. Complement fixation test for hydatid negative. Hearing not good. Urine: no albumin, no sugar."

At the time of the first exposure to deep X-ray therapy on July 13, 1922, the patient was brought in a car and had to be assisted to my room with considerable difficulty.

Note by Dr. Webb, made July 22, 1922.

"Came to see me at my rooms looking very much better. His headache and vomiting had improved. He counted fingers with ease and certainly the nystagmus and tremor of the tongue had disappeared and his gait was almost normal!"

Note by Dr. Rosenfield, August 30, 1922. "Optic atrophy of both discs."

On August 2, 1922, the patient reported that he was quite relieved of headaches. He felt stronger.

On September 5, 1922, he walked from Flinders Street Station to my rooms, a distance of more than half a mile. A second dose of X-rays was given.

On March 23, 1923, the improvement was maintained. He had vomited but twice in the past two or three months. He was able to play draughts and find his way across paddocks to visit neighbours. He did not suffer from headaches.

On June 10, 1923, the improvement was still maintained. He had only vomited four or five times this year.

Since then, however, owing to reappearance of vomiting and headache, a third dose has been administered, thirteen months after the last on October 4, 1923.

Case VI.—Lupus of Palate.

V.E., age seventeen, was treated at the Out-Patients Department of the Children's Hospital in 1919 for lupus. Two Wassermann tests were carried out on October 6 and 13. There was no reaction on either occasion. After being treated at the Ballarat Hospital, she was transferred to the Austin Hospital for Incurables. When I first saw her over a year ago she had considerable deformity of the cartilages of the nose resulting from lupus, also numerous small ulcers of the mucous membrane of the palate extending almost as far as the uvula.

Only one exposure of intensive X-rays was administered, namely on September 14, 1922.

Owing to pyorrhœa all her teeth have since been extracted. The palate has healed so completely that she has been able to wear a full set of teeth without any discomfort. She has been discharged from the Austin Hospital since March, 1923, and has been in constant employment since.

DR. L. J. CLENDINNEN said that he thought it advisable to sound a note of warning regarding what was to be expected from deep therapy, especially in view of the extravagant claims which had been made, particularly in the lay press. The immediate result of these was that X-ray therapists were inundated with patients in the most advanced and hopeless stages of malignant disease. Often unfortunate individuals in whom widely disseminated metastases were established, were sent along for treatment; even in them the local lesion often responded in a remarkable manner, but they died soon afterwards from deep deposits. With reference to the so-called "carcinoma dose," Dr. Clendinnen pointed out that this did not hold good in all cases; probably a great deal depended on the stage of the life cycle of the cells.

A full course was not given in one day. Not more than one portal was treated at a time with a full dose and generally two or more days were allowed to elapse before the next portal was attacked. At the present stage of deep therapy they could scarcely speak of cures and could do no more than show the immediate results.

DR. C. E. DENNIS congratulated Dr. Flecker on his paper and said he would like to have heard more about his failures. The variability in sensitiveness to radiation of apparently similar growths was to be borne in mind and it was hardly fair to ascribe failure to cure by deep therapy to prior treatment by radium and low-technique X-rays. Might not the tumours have been of a type intractable also to deep therapy from the outset?

In eighteen years' experience of radium therapy he had rarely seen recurrence in rodent ulcer not affecting bone or cartilage, provided the ulcer were efficiently treated. Reference had been made to Dr. McArthur's patient who had been affected with a malignant granuloma. He had seen this patient and had administered mild X-ray and radium treatment to the local ulceration, but in view of the presence of so much œdema he was afraid to give intensive radiation at the time on account of the risk of inducing laryngeal œdema. Would it not be better to divide the dose instead of giving a single large dose? By giving smaller doses at intervals of several days much of the distress which followed the single large dose, might be avoided.

DR. H. C. NOTT complimented Dr. Flecker on the compilation of his paper, but expressed disappointment in his opening remarks in which he referred disparagingly to the radiologist who wrote on Erlangen and deep therapy. The paper in question had been written for general practitioners in order to give them an idea to what type of malignant disease was suitable for X-ray treatment and the subject of technique was carefully avoided. However, as Dr. Flecker had re-opened the discussion, he wished to state that he objected to it being recorded that he disparaged deep therapy in any way; he was deeply interested in the subject. At the same time he considered that over-enthusiasm would do harm to their specialty.

He wished to ask Dr. Flecker whether he thought that the combined radiographic and radio-therapeutic apparatus of a maximum voltage of 200,000 would give as good

results as the more powerful apparatus designed for deep therapy only.

DR. V. McDOWALL asked Dr. Flecker several questions. Did he consider that every rodent ulcer could be cured by hard rays provided it had not already received treatment by other methods? What was the relative proportion of cures to failures in a series of selected cases? Did he consider X-ray treatment the only necessary treatment in epithelioma of the lip or would he regard a combination of X-rays and surgery as the most satisfactory method? Dr. McDowall expressed himself as pleased that Dr. Clendinnen had issued a warning to medical practitioners and to the general public; at present the public were expecting altogether too much from deep therapy.

DR. FLECKER in reply said that the advantages of bigger voltages were seen in the better response to treatment of such neoplasms as breast carcinoma and rodent ulcer. The dose was preferably given in one day, as it was thus easier to calculate it; the cumulative effect of divided doses was not the same as that obtained when the whole dose was given at one time. Rodent ulcers, if previously untreated, nearly always responded to deep therapy.

In reply to Dr. McDowall Dr. Flecker said that the degree of success attained depended very largely on the location of the growth, its type and stage of development. Radiologists saw much more of advanced than of early tumours, while surgeons based their figures on operable cases only. Epithelioma of the lip in the early stages was readily amenable to X-ray therapy. All such neoplasms dealt with surgically should certainly be irradiated before operation if not afterwards.

In reply to Dr. Nott Dr. Flecker said that high milliamperage was necessary in order to confine treatment to a reasonable time; if too low, treatment must be prolonged or administered with less filtration to the sacrifice of homogeneity.

DR. C. E. DENNIS exhibited a series of skiagrams. The first film was one in which a calcified abdominal gland was mistaken for a calculus in the upper portion of the ureter. The shadow was oval, uniform and corresponded in position with the upper part of the ureter. It moved synchronously with the kidney during respiration.

The second film revealed a diverticulum of the bladder. Radiograms had been taken of the bladder and diverticulum filled with 30% sodium bromide solution. Views had also been taken of the bladder drained and the diverticulum full.

The third film was that of a patient with an enlarged thymus. Radiograms taken before and after radium treatment were shown.

The fourth film illustrated an early stage of Paget's disease; the changes were limited to the tibia, patella and lower end of the femur.

The fifth was a skiagram showing spasm of the transverse colon and the sixth a skiagram from a patient affected with diverticulitis of the colon.

DR. K. STUART CROSS exhibited two skiagrams of patients with renal calculi. The first one appeared to be five centimetres below the lower pole of the left kidney. What was assumed to be the kidney was actually found at operation to be a large cyst in the upper pole, the remainder of the kidney being driven down into the iliac fossa. The calculus was found to be in the pelvis of the enlarged and displaced kidney.

The second skiagram showed a large mass lying in the right side of the abdomen. The mass was mobile on physical examination and proved to be a calculus lying in a large degenerated kidney sac.

LOW TECHNIQUE X-RAY THERAPY IN THE TREATMENT OF GLANDULAR DISEASES.

By C. E. DENNIS, O.B.E., M.D. (Melbourne),
Radiologist to the Department of Repatriation in Victoria.

Short papers and to the point are the life of a congress, for by avoiding all unnecessary and irrelevant matter, interest is kept from flagging and time allowed for the more important discussion. Therefore, I will give as briefly as possible my experiences on the subject on hand.

I will not touch on deep therapy, by which term is meant, treatment in which a potential of over one hundred kilovolts is applied to the X-ray tube, and will not touch on malignant diseases which would enlarge the scope of this paper too much.

Tonsils, Chronically Enlarged and Inflamed.

Following on the excellent results reported by several well-known radiologists in America obtained in the treatment of these conditions, I have treated five or six in the last eighteen months. All were adults well over thirty years of age, except one young married woman, and operation had been refused by all or had not been advocated. They were all country patients but one and did not have as thorough treatment as I should have liked. All improved very considerably, as shown by reduction in size in the tonsils, by the clearing up of the inflammatory condition, with freedom from colds and general improvement in health. The youngest patient, a thin delicate woman, who had slightly enlarged tonsils with follicular exudate and who was continually suffering from colds and sore throats, has been exceptionally well and free from colds all this trying winter.

Four or five weekly treatments were given to each tonsillar area. Filters of four millimetres of aluminium were used and about a quarter erythema dose given each week, consequently no ill results followed treatment. One or two remarked on the improvement in hearing after the treatment and cessation of noises in the ears. Other workers have mentioned this and it is ascribed to diminution of congestion of the Eustachian tubes or shrinkage of the lymphoid tissue at the entrance to the tubes.

Enlarged Cervical Glands (Tuberculous).

In these cases filtration and dosage is similar to the above, namely, three to four millimetres of aluminium filter and one quarter erythema dose of rays at twenty-five centimetres (ten inches) focal distance. No treatment is given where there is fluctuation pointing to an unopened abscess. In simple enlargement or after abscesses have been drained, whether fistulae are present or not, steady and gratifying improvement as a rule occurs. Occasionally a patient is met with who does not improve, but rarely. Local improvement is accompanied by general improvement in health, increased appetite and so forth. In no circumstance should any skin erythema be produced. In fact, I believe, too large doses are harmful, as in chronic glandular and other disease small doses of X-ray produce a general tonic effect and appear to raise the resistance of the individual to infection. I have held this view now for many years.

I would like to refer here to an unusual case of massive and rapid involvement of the cervical glands on both sides of the neck in a young man. It was diagnosed as lymphosarcoma. Pathological examination of an excised gland revealed it to be a case of acute tuberculous glandular enlargement. As it was inoperable, the patient was referred to me for X-ray treatment and the response to treatment was extraordinarily rapid. His health improved quickly and he was soon able to resume work. After three months' treatment he had merely a chain of small hard fibrous nodules in place of the massive glandular enlargement and he is in excellent health.

In addition to the X-ray treatment, of course, fresh air, liberal diet and cod-liver oil are advised in these cases.

In post-operative cases in which there is much scarring or with hypertrophic scars which are so common in these conditions, the improvement in the appearances of the scars alone warrants the use of such treatment.

Thyroid Enlargement.

Ten or twelve years ago I treated some simple goitres of the large soft type of general enlargement of the gland with resulting reduction in size, but I do not think it advisable to use X-ray therapy on account of the possibility of producing myxoedema. However, a few treatments may not do any harm.

Toxic adenomata are purely surgical cases and should not be treated by X-rays.

In exophthalmic goitre results are as a rule excellent, but if no improvement follows in a month or six weeks after treatment is begun, I think that the patient should be referred to a surgeon for consultation.

The patients who respond best, are those with large soft pulsating thyroid glands. They show the typical rapid pulse, exophthalmos and tremor and complain of nervousness, excessive perspiration, palpitation and often diarrhoeal attacks and weakness. When improvement begins, the patient reports amelioration of the symptoms in the order named, the slowing of the pulse, tremor and exophthalmos as a rule take longer to disappear.

Some of the worst cases have shown the most rapid response, one patient in whom half the gland had been removed surgically and who had relapsed into a worse condition than before operation, improved remarkably.

General treatment, including complete rest, liberal diet *et cetera*, must be attended to, though some patients have improved while continuing their duties. These patients respond slowly, however, and if sent away for a holiday often return apparently well after having had a course of X-ray treatments.

I use three to four millimetre aluminium filter and in no patients have I ever induced any erythema nor have had any ill effects. About one-quarter of an erythema dose is given to each side of the gland once a week.

Persistent Thymus Gland.

I have only had one patient. It was a baby of seven weeks with stridulous respiration, puny and ill-nourished. The radiogram showed a very large thymus gland. I treated it with mild applications of radium, ninety milligrammes of the bromide filtered with 0.5 millimetre of silver and three millimetres of rubber, giving doses of one to two hours a week. There has been much improvement

with reduction in the size of the thymus in a few weeks as is shown by the radiograms.

Prostatic Lesions.

Some of the most pleasing and remarkable results I have seen, have been in cases of enlarged prostate with retention or retention and overflow in old men over sixty-five years of age. The older the patient, the better the result. Under the age of sixty-five results have, as a rule, been unsatisfactory, at least with the relatively small doses that are effective in the aged. I began treating these patients about the year 1910 at Ballarat. I then used a filter of one millimetre of glass and so good were my results that while I was in Ballarat till May, 1914, no man of over sixty-five years of age was operated on for enlarged prostate at the public hospital.

I reported a series of cases with details in the *Australian Medical Journal* of May, 1911, and in the *Australian Medical Journal* of December 14, 1912.

The treatment is simple. I have a chair made so that the X-ray tube can be placed underneath. The patient sits on this chair and the rays are directed through the perineum. Treatment can be given once a week or twice, but not more than one-quarter of an erythema dose is given and as a rule in from ten to fifteen days the patient begins to benefit. Many of my patients were leading a catheter life and were enabled to pass their urine within ten days of starting treatment and to leave off using the catheter in less than a fortnight. The most satisfactory results were in patients with large, soft glands; the small, fibrous type responds less uniformly to treatment.

Why the treatment is so successful I cannot say, for sufficient irradiation was not given to cause the prostate to atrophy to any appreciable extent. I have known of several patients who lived several years without recurrence of the trouble, though recurrences do occur, for instance after a chill, but they respond to further dosage.

No erythema has ever been produced in these patients by me. As in other conditions above mentioned, the irradiation is almost always followed by a distinct improvement in health.

Lymphadenoma.

In this disease the reduction of the glands is very rapid as a rule. They seem to melt away, but much heavier filtration and larger doses are necessary. There is unfortunately a tendency, if treatment is not vigorous and thorough, for the condition to recrudescence, so that after the glands have subsided, prophylactic doses should be given from time to time.

DR. L. J. CLENDINNEN said that his experience enabled him to subscribe to almost everything Dr. Dennis had said; this branch of radio-therapy was by far the most pleasing and successful. In tonsillar disease, when surgery was contra-indicated by reason of hæmophilia or cardiac lesion, radio-therapy had a distinct rôle and in his small experience had proved very satisfactory.

In tuberculous cervical adenitis it was desirable to irradiate the whole of the affected area. By this means the peri-glandular infiltration was reduced and glands in the early stages of tuberculous inflammation frequently subsided. However, if caseation had commenced, radiation rather accelerated the breaking down process.

In post-operative hypertrophic scarring radio-therapy was worth while for the cosmetic effect.

In Hodgkin's disease the immediate effects of radio-therapy were excellent, but it was very necessary to anticipate the tendency to recurrence and repeat the course of treatment at intervals of six months.

Dr. H. FLECKER conveyed his thanks to Dr. Dennis and said that, while he had had no experience of enlarged tonsils, he had obtained uniformly good results in the treatment of tuberculous glands. One patient who had glands removed from both sides of her neck two years previously, had been sent to him by her surgeon for the treatment by X-rays for a recurrence of the disease. Not only had the glands since disappeared, but the operation scars had been rendered much more supple.

The pastille as a measure of dosage though of much value for surface lesions must be considered inaccurate when applied to deeper structures. With ordinary low voltage superficial glands must receive a much larger dose than deeper glands. It had been pointed out by Boggs that almost every tuberculous cervical adenitis would respond to X-ray treatment and that surgical removal of affected glands was scarcely ever necessary. At a recent discussion in Great Britain on the treatment of tuberculous cervical adenitis very little reference was made to X-ray therapy. His experience in the radio-therapy of simple enlarged prostates was that they also responded rapidly.

TREATMENT OF EXOPHTHALMIC GOITRE.

By J. G. EDWARDS, M.B., M.S.,
Honorary Radiologist to the Sydney

The term hyperthyroidism is preferable to that of exophthalmic goitre.

From the radiological point of view this clinical entity is divisible into two classes: (i.) Hyperthyroidism with exophthalmos and the various toxic symptoms; (ii.) hyperthyroidism accompanying an adenomatous enlargement of the thyroid gland.

In the first class the thyroid may show little enlargement, in fact the most toxic cases show little enlargement.

In the second class the toxæmia may be severe but in addition we have the definite thyroid enlargement.

This second class of case has the toxic symptoms readily relieved by radiation, but the goitre itself should receive surgical attention. Previous radiation, if carried out in the manner to be described later, will not increase the difficulty of the surgical procedure.

Cystic goitre without toxæmia should not be treated by radiation. The greater the toxæmia, the more suitable the case for X-ray treatment and the better the prognosis.

Ordinary medical measures may be employed during the process of radiation, but these we need not refer to in detail.

Rest in the early stages of treatment is essential with relief from worry and excitement and it is very necessary for the physician to fill the patient with confidence and promise of an ultimate cure.

All foci of septic absorption should be cleared up before treatment is commenced, particular attention being paid to the tonsils.

We have had no personal experience in the control of these cases during treatment by means of basal meta-

bolism estimation, but authorities generally agree that after the commencement of radiation, the metabolism rate rapidly falls to normal.

Since 1915 with the advent of the Coolidge tube and transformer apparatus there has been a rapid increase in the number of patients treated by radiation and the reason for this is that the better results produced by this more accurate dosage has led to a greater number of patients being referred to the radiologist instead of being handed over to the surgeon.

From July, 1922, to June, 1923, we treated fifty-six female and four male patients at the Sydney Hospital and these received two hundred and fifty-three sittings, each sitting consisting of heavy dosage to three areas. During the same period only three patients with thyreo-toxic goitre entered the operation theatre. Fifteen of these sixty patients failed to report after one or two sittings and must be excluded from this series. We thus find forty-five patients averaging 5.2 sittings each.

At the time of discharge from the therapeutic department all these patients were free from toxic symptoms though exophthalmos and enlargement of the thyroid were still present. These latter signs gradually disappear after cure of the toxic symptoms and we always warn patients that it will be several months before changes in the size of the gland will be noted and that it will take a still longer period for the exophthalmos to disappear.

The method of treatment we employ is as follows. Each sitting consists of three applications of a four-fifth erythema dose filtered through two millimetres of aluminium at a kilovoltage of eighty-five; one application is given over the right lobe of the thyroid, one over the left and the third over the *manubrium sterni*.

After this first sitting the patient rests for three weeks, when the applications are repeated and after a further rest of three weeks the dosage is again given.

After eight to twelve weeks rest from treatment, the cycle of three sittings is again repeated; should a third or fourth cycle be necessary, a rest of three months should occur between the cycles.

All patients show improvement after the first cycle; the nervousness is lessened, the patient sleeps and the heart's action has considerably slowed.

The majority of patients are free from symptoms after the second cycle and a third or fourth cycle is rarely required.

With the dosage recommended there is no risk of reaction on the skin and we have only seen one of our patients develop teleangectases many months after the cessation of treatment.

In conclusion we would say that this method of treatment has no death rate.

DISCUSSION ON TUBERCULOSIS.

Combined Session of all Sections.

A meeting of all the Sections of Congress was held on November 17, 1923, with MR. G. A. SYME, the PRESIDENT, in the chair.

DR. W. J. PENFOLD, Director of the Commonwealth Serum Laboratories, dealt with the incidence of tuberculosis as revealed by the evidence at autopsy and by

biological tests. In the first place he referred to infection of cattle with tuberculosis and stated that only a few figures were available. Examination had been carried out of six hundred dairy cattle. They had found that over 16% of the cows supplying milk for human consumption reacted to the tuberculin test, but the proportion of animals in the stud farms of Victoria was 3%. One firm which had supplied bottled milk for infants, had obtained milk from cows of whom 32% were tuberculous. In view of the fact that there was only 3% of tuberculosis among the stud animals, it should be an easy matter to clear the herds of this disease. This matter had been before the public for a long time and it had been held that the problem was too extensive to handle. He thought that the dairymen were as anxious as anyone to meet the difficulty. The methods of protecting the public against infection from this source resolved themselves into the elimination of all infected cows from the herds or the pasteurization or boiling of all milk before distribution. Dr. Penfold held that one or other of these measures should be carried out. If this were compulsory there would be no difficulty in getting rid of bovine tuberculosis.

In the next place Dr. Penfold referred to the types of tubercle bacilli found in human beings. An examination of one hundred and fifty-five samples of sputum and two further samples of material had revealed that tubercle bacilli were present in seventy. In no instance was the bacillus of the bovine type. This would indicate that bovine infection in adults was not a problem that demanded much consideration. Seventy-two samples had been taken at the Children's Hospital, Carlton, from sixty children. In forty-eight tubercle bacilli had been found. Of these nine had been of the bovine type and thirty-nine of the human type. Eight of the children had been under the age of four years; the age of the ninth had not been recorded.

Dr. Penfold next turned to the *post mortem* and biological evidence that had been collected. A large amount of work had been done at the Melbourne Hospital and a considerable amount of information had been collected from Saint Vincent's Hospital and the Adelaide Hospital. Unfortunately they had obtained no figures from Sydney. From the results of the von Pirquet test and from pathological data it appeared that the incidence of tuberculosis in the population of Australia was slightly greater than in Great Britain or elsewhere. This was contrary to popular belief. The von Pirquet test applied to second and third year medical students had revealed 70% of infection; among school children the incidence of infection was 71%, while among infants under four years of age it was 70%. The conditions among the hospital population were very different. In the Melbourne and Adelaide Hospitals 60% of all patients reacted to the test, while at the Royal Prince Alfred Hospital only 30% reacted. Then at the Children's Hospital, Carlton, only 20% reacted. He suggested that certain diseases might lead to a temporary inhibition of the reaction in latent tuberculosis, so that the proportion of reactions would be reduced in patients in hospitals. He advocated the setting apart of money and men to study many matters in regard to the incidence of the disease.

DR. S. A. SMITH (Sydney) stated that in the discussion in the Section of Medicine the fact had emerged that there was a considerable incidence of active and latent tuberculosis among the general population. It was the duty of the clinician to recognize the active form of the disease as early as possible, in order that the possible sources of infection might be dealt with. Early recognition of

tuberculosis was not an easy matter. There was no single criterion on which the diagnosis could be based. There were the signs of bacterial intoxication and the constitutional disturbance, the clinical signs and the response to the tuberculin test. No one of these factors alone could yield a sure diagnosis of early disease. All the factors must be considered. In the individual patient this necessitated care and patience. It was the duty of medical practitioners to take that care and to have that patience. He pointed out that the diagnosis was needed when the physical signs were not obvious. The tuberculin test could not be properly applied unless the patient were kept in bed, preferably in hospital. All this took time and trouble and a grave personal responsibility attached to the work. He held that it was not fair to ask general practitioners to do it, unless facilities for the work were provided. The difficulty was not as great for those attached to the large public hospitals. He therefore urged that provision should be made whereby these forms of investigations could be carried out in all parts of the Commonwealth. Dispensaries should be attached to the great public hospitals, where the advantages of the resources of the pathological, of the X-ray and of the ear, nose and throat departments were available. Elsewhere special facilities should be provided to make the way easy for the individual practitioner to fulfil his duty to his patients and to the community.

DR. E. S. MORRIS, Chief Health Officer of Tasmania, referred to the evidence of the association between tuberculosis and overcrowding. There was no doubt that this disease arose from causes operating in Australia and that the importation of tuberculosis was a negligible factor. It appeared that the intestinal route of infection by means of food stuffs was of relatively minor importance. He expressed surprise that while Dr. Ferguson had failed to find any milk containing tubercle bacilli on the market in Sydney, Dr. Penfold had found tuberculosis in 16.83% of dairy cattle, while between 4% and 10% of the animals killed at the abattoirs had been found to be tuberculous. Again, Dr. Harvey Sutton had produced evidence to show that tuberculosis was very limited among school children and yet a relatively high proportion of these children reacted to the von Pirquet test. Dr. S. A. Smith had shown that among the mining population of Broken Hill "dusted" persons were twenty-three times as susceptible to tuberculosis as those who were not "dusted." On the other hand the incidence of tuberculosis among persons with pneumoconiosis who lived in rural districts, was slight, but when these people lived in centres with dense populations, the incidence was thirteen times greater. After having gathered other pieces of evidence he stated that there seemed to be cause to assume that the infective individual was even more important than overcrowding and other housing conditions. The person with an infectious disease was usually regarded as the propagating centre. This should be applied to tuberculosis as well as to other diseases. He recognized that the information concerning the ætiological factors was incomplete and demanded amplification in many directions. He found that improved sanitation had produced beneficial results and should be continued. This method of attacking the problem, however, was very slow. To attack the disease by curing persons with it in an early stage was the second method. This meant the employment of the sanatorium and of the dispensary. The third proposal was the segregation or other adequate control of the person with advanced disease. Dr. Morris said that he was not clear whether notification as a means to an end had been condemned or merely notification which was followed by

action that harassed the patient. He held that compulsory segregation, except in the rarest circumstances, should be avoided. It was useless unless financial help could be given to the dependants of the patient. This was very important. Dr. Morris pointed out that here again it was evident that public health was purchasable at a price. The fourth proposal was to control the disease by immunizing the population. There was not sufficient evidence available to justify any expression of opinion in this connexion. The fifth suggestion was the eradication of bovine tuberculosis. The evidence was scanty and it was still impossible to say whether the bovine or the human bacilli were the most important as sources of infection.

DR. J. H. L. CUMPSTON, Director-General of Health of the Commonwealth, pointed out that it was exactly forty years since Sir Harry Allen, as member of the Departmental Committee on Meat Control, had urged the adoption of certain standards of meat inspection and meat control which had become the basis of the act. That measure had remained in operation without material amendment for forty years. Ten years later a Royal Commission had persuaded the Imperial Parliament to pass a measure practically identical with that of Victoria. It thus appeared that Victoria had adopted these measures years before any other country in the world and he wished to emphasize the fact that Sir Harry Allen had been responsible to a very large extent for this pioneering work.

Dr Cumpston exhibited a model of a graph showing the mortality rates of the various diseases. Tuberculosis appeared as the fourth in order of the killing disease. It was responsible for one-sixteenth of the total number of deaths. The mortality of pulmonary tuberculosis was 53 per 100,000 of population, males 63 and females 43. In the course of forty-two years there had been a fall in the death rate from 135 to 53, that was a fall of 55%. This represented the greatest fall that had taken place in any country. There had been a break in the fall from 1917 to 1921. In Great Britain this break had been even more apparent. There was evidence to show that this break was a direct result of war conditions. In regard to "other forms of tuberculosis" the maximum mortality rates were from 45 to 49 in males and 25 to 29 in females. The highest incidence was among infants in the first five years of life. Dr. Cumpston pointed out that there was no statistical evidence of value in regard to the influence of occupation on the incidence of tuberculosis. The incidence of pulmonary tuberculosis was worst in Bendigo and Adelaide; Hobart and Launceston were worse than Brisbane, Sydney or Perth. The mortality in Launceston had remained stationary for twenty years. In regard to the non-pulmonary forms, the incidence was practically the same in all the capital cities with the exception of Brisbane where it was very low, three per hundred thousand. He had evidence to show that the death rate from pulmonary tuberculosis was considerably less among Australians than among non-Australians living in Australia. While suggestions might be put forward to explain this and other facts, it was obvious that further information was needed before any definite conclusions could be reached. He showed that the conditions were more favourable in Queensland than in Victoria, but it was certain that climate was not operating in producing this result. There were many points that were not clear. There was the significance of age and sex and of occupation on the incidence of the disease and on its mortality. In other directions there was a lack of statistical information. All this should be prevented.

DR. F. S. HONE (Adelaide) gave a summary of the

statistical, pathological, clinical and administrative findings and presented a motion that had been drafted after consultation with the office-bearers of the several Sections concerned. He pointed out that in the past resolutions had been passed at congresses at the final meetings and the majority of these had remained pious hopes. It had been determined that any resolutions passed at the present Congress should be transmitted to the Federal Committee which was constituted in such a manner that the necessary action could be taken to give effect to the considered opinion of the members. They had felt that it would be little short of a tragedy if the Congress were to terminate without passing any resolution. They were creating traditions. At the Auckland Congress they had discussed a report on syphilis and had made recommendations of an important kind. Sir Harry Allen had taken a prominent part in this work. He did not hesitate to assert that the steps taken had been a direct factor in producing the agitation for the suppression of this disease. The outcome had been the passing of the legislative measures in every State of Australia.

The subject they had been discussing demanded the greatest care and the greatest accuracy in order that the information might be quite complete. They had to deal both with tuberculous infection and active tuberculosis. There was a call for accuracy in regard to the incidence of the disease in both its latent and its active forms. At present it was impossible to obtain this information. They had heard that nothing was known in regard to the influence of occupation on the incidence and mortality of tuberculosis. The difficulty was that there was a great paucity of information. Then in regard to the question of the von Pirquet reactions and the *post mortem* evidence there were the conflicting results that so far had been obtained. Why was it that latent tuberculosis was so widespread among the general population and so low in the hospitals in Melbourne and Adelaide? Why did the people in Sydney respond so freely to the von Pirquet test, while those in Melbourne and Adelaide did not? Why was there so little clinical tuberculosis among school children and yet so many of these children reacted to the von Pirquet test? Why was beautiful and apparently healthy Adelaide the city with the highest tuberculosis mortality? These and many other anomalies had to be explained. It was necessary to recognize that they were only touching the fringe of the subject. They were at the beginning of an extensive coordinated attempt to cope with this disease. More investigation was needed. Tuberculosis and syphilis were the two greatest national diseases and he was satisfied that as chronic infections they required a different method of control to that employed for the acute infections. Both these diseases had wormed their way into the economical and social life of the community and it was imperative that they should be investigated from all points of view. The Prime Minister had announced that he realized the serious nature of these problems and that they had to be faced. He suggested that Congress should put him to the test and see whether he was prepared to translate his words into actions. They should ask him to institute an investigation on a large scale in order that they might know where they stood. He asked Congress to determine that between then and the time of the next Congress they would learn about all the matters still enshrouded in mystery. The practising part of the medical profession must be brought into more intimate contact with the health authorities and must be induced to prevent patients with active tuberculosis from spreading the disease in the community. There was the

problem of the linking up of the tuberculosis dispensary, the sanatorium, the hospital and the farm colony. He was satisfied that the problem of tuberculosis was the same as the problem of all other infective diseases. They must attack the disease either at its source or in its transit from the source to the victims. There was some evidence that it was not encouraging to endeavour to attack it by concentrating their attention on the resistance of the individual. He therefore begged to move as follows:

The preliminary inquiries which have been made for presentation to this Congress reveal a large amount of tuberculous infection both in early and in adult human life and an unexpectedly large amount of tuberculosis in dairy cattle, but the evidence available at present does not indicate sufficiently the nature of the measures which should be adopted for the control of tuberculosis.

In view of this position this Congress, the first Australasian Medical Congress of the British Medical Association, resolves that the Commonwealth be urged to arrange for and put into operation a national investigation into the facts of tuberculosis in Australia, with special reference to the extent of infection in the community, the sources of infection and the relative importance of these sources.

It is also urged on every member of the medical profession the duty by personal effort of joining with the responsible authorities in fighting the disease in every possible way, particularly by attention to early diagnosis and the control of the human infection at its source.

As an aid in bringing this about it reaffirms the resolution of the Australasian Medical Congress, Brisbane, 1920:

That in the interests of public health and of accurate diagnosis it is desirable that laboratories be established at principal centres of extra-metropolitan population throughout the Commonwealth and that a concerted scheme for the whole Commonwealth is the best calculated to give effective results in this respect.

DR. GRAHAM BUTLER, in seconding the motion, said that he agreed to do so only in the belief that it was not, like so many Congress resolutions in the past, a pious hope to be quickly forgotten, but that it did indeed express a resolve, one which had behind it a permanent and responsible executive machinery, the Federal Committee of the British Medical Association.

It had been pointed out with acclaim and demonstrated by interesting models that tuberculosis had declined and that this decline in some degree continued. But the position was far from being one which they could contemplate with any degree of serenity. The medical profession in discovering that tuberculosis like its close congener leprosy was a communicable and contagious disease and by passing on to humanity this still undigested knowledge, had given them to eat of the tree of knowledge of evil with consequences which were very tragic. The tuberculous, like the leper, was becoming a pariah in the community. He was expelled from the boarding house and had nowhere to lay his head; the wife of the consumptive was torn between wifely duty and dread. From them had come this distress; from them must come also salvation. The profession and the community could not rest in its efforts and must feel disgraced until tuberculosis was as rare and as under control as was leprosy.

It seemed to him that as a profession they had come to the breaking in much froth and pother of one of the waves of advance which had characterized the problem of

tuberculosis. What was most urgently needed was impetus for a fresh advance. This impetus could only come in new knowledge and in his view the knowledge that was most urgently required was that of the actual means of transmission of the disease. They appeared to have come to a bag's end in this respect. In company with several hundred others he had attended the meetings of the august Section of pure medicine and with about thirty those of the Section of Preventive Medicine. He had been unable to resist the feeling that when contemplating measures of treatment, they were spending much time and labour with little (if any) advance. They were indeed like white mice turning the endless treadmill of a revolving wheel; while, on the preventive side on the other hand, he had felt in the papers and discussions the inspiration of real advance based on new knowledge and more vital outlook, an inspiration which was operative alike on the general practitioner in his daily dealing with his cases and on the specialist in public health.

More light was urgently wanted in exact knowledge of the real processes of contagion, the mechanics so to speak of the transmission of the disease. At present, they were divided into different schools. While Calmette for instance held the theory of infantile transmission by the mouth, the ordinary view of infection by inhalation of dust and breath was still that which governed procedure.

The motion gave promise of increase in exact knowledge of susceptibility to and modes of transmission of the disease: and as such he strongly supported it.

DR. CAMAC WILKINSON said that the Congress had been engaged in the consideration of the prevention of tuberculosis and it was well to recognize as a principle of hygiene and to strike infection at its source. He believed that treatment was a valuable method of prevention because specific treatment had the effect of ridding the expectoration of tubercle bacilli in 50% of the cases. They could prevent tuberculosis from converting open (infectious) cases of tuberculosis into closed (or non-infectious) cases and prevent closed cases from becoming open. If specific measures were used not only for treatment but for diagnosis, they could begin to deal with tuberculosis in a way that would vastly improve their methods and results of treatment and help also to diminish the recurrence of tuberculosis.

He had just published records that showed results far better than any record published in any institution in any country.

Briefly these were: in the first stage no death from tuberculosis occurred in cases controlled ten years after examination and in the second stage 67% were alive eight to ten years after treatment. His results had been published in a pamphlet. "The Tuberculin Dispensary for the Poor."

DR. J. W. SPRINGTHORPE said whilst agreeing with Dr. Wilkinson as to the value and importance of attempting to secure immunity by lessening infectivity, he ventured to think that they might go further than wait for preventive injections. From the point of view of later prevention he cordially endorsed new proposals brought forward by Dr. Hone. The different sectional reporters had also shown the value of the discussions in the different Sections. But surely there was something more. Was it not a fact that personal health was a fundamental factor in controlling the entrance and limiting the development of tuberculous infection? If so, the inculcation of the principles of personal health everywhere, to everybody, at every time should surely be essential. At present education as a system was concerned with many

useful things, but could it be said that in the curriculum anything like sufficient place was given to the question of personal health. Children learned reading and writing, geometry and nature study, but left school quite ignorant of the laws of health. These laws were as inexorable as the laws of mathematics and to their lives generally far more important. While thus coordinating and classifying knowledge and powers as to the other factors, the profession should emphasize this as basal.

He would therefore ask the Executive Committee to consider the addition of some such clause as would bring under the notice of the authorities the necessity of making instruction in personal health a basal fact of normal education. He hoped that the Congress would not only make the great advance which it had already formulated, but the still greater one of being the first to take action in terms of health and not of disease.

DR. SINCLAIR GILLIES said that he agreed with Dr. Butler that at such meetings there was much froth. Each Congress passed pious resolutions which were never acted on. Fifteen years before the necessity for sanatoria, dispensaries and after-care associations had been urged. But what had been done? Where were the dispensaries? After ten years' experience at such an institution as the Royal Prince Alfred Hospital, he had been very impressed with the fact that the dispensary was one of the most important factors in control. The dispensary through its visiting nurse discovered the foci of infection in a way that nothing else did. He urged the Federal Committee to bring pressure on the Government to help the establishment of such institutions in connexion with all large hospitals. In such way one practical step would be taken to remove some of the froth and get at the good liquor beneath.

DR. W. KENT HUGHES urged the eradication of the tuberculous cow. Medical men should urge and assist in the passage of the compensation bill. It was true that it dealt only with pleuro-pneumonia and that was not of much interest to medical men.

DR. HARVEY SUTTON spoke in support of Dr. Springthorpe's and Dr. Kent Hughes's suggestions. First not only health teaching but adequate health teaching in schools was required. At present most departments gave health instruction to the extent of twenty minutes to half an hour per week. In the infants' schools in Sydney it is found possible and desirable to give health teaching either directly or by correlation with other subjects for five days a week.

He pointed out that the investigation of the school medical officers included only clinical tuberculosis and it included the findings of the general profession. Every child in the State must be on a school roll and every head teacher was asked to report any child known to be away on account of tuberculosis, that was when the disease was discovered by general practitioners. These amounted to ten out of the twenty-five in the seventy thousand children dealt with. The von Pirquet findings in no way impugned the accuracy of the clinical findings. While they affirmed the rarity of active tuberculosis in school children, they did not deny the likelihood of existing infection. They considered as their duty the preservation of the health of children not only in the present, but also for the future. Their great difficulty was the failure in dietary for children. Pure milk was difficult to obtain; Friday's milk, for example, was often delivered on Sunday and the pernicious system of "block days" was not unknown. Further, milk was expensive and children were thus deprived of their main protective

food essential to growth and health as McCollum had pointed out. The need for a pure milk supply was therefore worthy of the support of Congress.

DR. F. GUY GRIFFITHS said that the story of tuberculosis among Britons in Australia extends over one hundred and fifty-three years. Forby Sutherland, one of Captain Cook's sailors, had died of phthisis and had been buried in New South Wales, in May, 1770. In the interval much had been done, as was witnessed by the reduction of more than 50% in the mortality during the forty years; but much remained to be done.

Three points well known to some for years but not generally accepted in Australia had been made by earlier speakers; the small amount of bovine infection, the need of attracting, not compelling, highly infective sufferers from advanced disease into hospitals and the value of curing patients in early disease so as to prevent them becoming later sources of infection.

He hoped that later they might realize the relative valuelessness of the von Pirquet test, little informative in itself and useless for comparison when made by varying and diverse methods.

DR. R. ARTHUR, M.L.A., said that along with the teaching of health should go the supplying of means for its attainment. The Federal Government should be urged to consider the advisability of modifying the basis of the basis wage so as to adopt the principle of the family wage as advocated by Mr. A. B. Piddington. The present system penalized large families. The larger the family, the worse became the conditions under which it lived. The evil was aggravated when the bread winner became infected with tuberculosis. Then the housing conditions and the food supply generally deteriorated and the children ran increased risks of infection.

DR. MCINTYRE SINCLAIR supported the motion submitted to Congress, but regretted that it did not go far enough. Several valuable resolutions had been passed at sectional meetings, but he understood these had been forwarded to Federal Committee and might be brought up again from that Committee at next Congress or some future indefinite time. He suggested that the machinery of Congress might be amended so that such sectional resolutions on an important subject like tuberculosis might have been finalized and brought to fruition at this final meeting of Congress. The profession and the public were looking for guidance as a result of their deliberations and should get it without undue delay.

For instance, a pronouncement might have been made on the subject of bovine tuberculosis; on the necessity for the cooperation of the various agencies in the anti-tuberculosis campaign; or again on the value of sunlight, fresh air, good housing accommodation and good working conditions in the fight against tuberculosis. On these latter aspects the profession was unanimous.

Regarding infection a great deal of time in the Sections had been taken up with the tubercle bacillus as the causative and infective agent and perhaps not enough stress had been laid on the soil to which the bacillus gained access, whether resistant or non-resistant. This was an equally important, if not more important factor.

The von Pirquet reaction in adults he regarded as evidence of tuberculous infection and not of clinical tuberculosis. The fact that so many persons in perfect health exhibited this reaction, showed the prevalence of tuberculous infection in civilized races and further research was needed to ascertain the actual incidence of tuberculous infection in Australia.

Numerous European authorities declared that 100% of

adults in civilized communities were infected with tuberculosis (though not to the extent of clinical tuberculosis) at some period of their lives and yet in Australia for instance only 6% died from this disease. This proved that the soil of the individual tissues was a most important factor as apart from the seed of the tubercle bacillus as the causative agent. Polynesian and African and other uncivilized races brought in contact with tuberculous infection for the first time developed tuberculosis in a most virulent form, as for instance in the African labour corps in France during the recent war. They died of a rapidly fatal form of tuberculosis, in some cases in a few weeks from the time of onset. In civilized races who had been in contact with tuberculosis for many generations, more resistance to the disease was exhibited, but even yet one occasionally met with rapidly fatal cases of the uncivilized type. He had seen such cases in Australia. The point he wished to make was that Nature in her own way was working out a cure by means of tuberculinization of the human race. The 6% of deaths shown in Dr. Cumpston's tables represented the failures of immunization. When ultimately 100% were tuberculinized and yet no one died of tuberculosis, the disease would be conquered. Of course, their objective in the meantime was to discover some vaccine or cure and so anticipate Nature's efforts.

He had pleasure in supporting the motion even though his pronouncement fell short of what he had hoped for from this Congress.

DR. T. W. SINCLAIR said that he supported the resolution. He referred to a paper read by Dr. Gordon Hislop who had described the very complete system of the control of this disease as carried out at Brompton under the London County Council. He welcomed the work done at the dispensary at Royal Prince Alfred Hospital referred to by Dr. Sinclair Gillies and Dr. C. G. McDonald. The dis-

pensary must obviously be a means to the early detection of the disease. Early diagnosis was more easily available to those of the community who were in better circumstances. The dispensary would give the advantage to those of the humbler and poorer ranks of society. Tuberculosis was a disease of the poorer classes, many of whom were loath to give up work or consult a doctor as they feared the result of a diagnosis especially such as tuberculosis. With the aid of a dispensary and this should be associated with existing hospitals, early information of the incidence of the disease could be secured, while arrangements could be made for examination of contacts. If dispensaries were established at the teaching general hospitals, it would give a different colour to the ideas of students in the recognition of this disease.

On the subject of bovine tuberculosis he welcomed the proposed effort to eliminate this disease in milch cows by legislature and other means. In America where great attention had been paid to milk supply and legislative provisions were especially strict, it had been found that there was comparatively little of the highest grade-certified milk from tuberculin tested cows sold. For example in the city of Chicago in 1921 the amount of certified milk sold was 2% of the total, while the balance of 98% was Pasteurized. While endeavouring to obtain a pure milk supply, the question of cost must be remembered.

SIR WILLIAM MACEWEN said prevention of tuberculosis should commence with the cattle. He instanced an experience of a cow condemned as being diseased, the farmer ceased sending the milk to town and fed his pigs with it. The next litter of pigs were wasters, the cow was slaughtered and the mesenteric glands were found to be diseased and there was also an abscess in the lung.

The motion was carried without opposition.

CORRIGENDA.

Dr. F. L. Apperly,

page 69, left hand column, line 38;

For "The fact that there were not more children like it" read "The fact that in the majority of cases these conditions were largely preventible."

page 69, left hand column, line 47;

For "an infected tonsil" read "an uninfected tonsil."

Dr. Sydney Pern,

page 72, right hand column, line 2;

For "10%" read "100%."

page 73, last paragraph of left hand column. Dr.

Pern's remarks had reference to exophthalmic goitre and should have been included in the discussion on pages 81 and 82.

Dr. J. Lockhart Gibson,

page 350, left hand column, line 12;

For "There were signs of iritis" read "There were no signs of iritis."

page 351, right hand column, line 29;

For "If 'sympathetic' is meant" read "If 'sympathetic' it meant."

Dr. D. D. Paton,

page 341, left hand column, line 6, 56, 58, 59, 61 and 62 and right hand column, lines 1 and 15.

Where the *per mille* sign is used, read "%."

ADDENDUM.

Renal Insufficiency.

Through an oversight the following remarks by Dr. Gordon Craig, Dr. S. Harry Harris and Dr. Julian Smith were omitted from the record of the discussion on renal insufficiency at a combined meeting of the Sections of Medicine, Surgery and Pathology, published on pages 65 and 66 (March 1, 1924).

DR. R. GORDON CRAIG said that there was a difference between the medical and the surgical diseases of the kidney. When renal insufficiency was encountered in surgery, it was usually due to a removable cause, often of an obstructive nature. If this cause were removed, the function of the kidney could be greatly restored. Rose Bradford had shown that two-thirds of the kidney could be removed in dogs and that the remainder was sufficient to maintain life. Yet if three-quarters were removed, death rapidly followed. In medicine there were no tests which could reveal the first stages of disease of the kidney. It was only when the danger margin was being approached that the tests yielded results. At this stage the causes were exceedingly difficult to eliminate. Cushny had stated that the glomerular and tubular functions were distinct and that in the tubules reabsorption of fluid took place. Two young American physiologists had recently been able to confirm Cushny's views by microscopical dissection of the kidney and the collection of urine from the glomeruli and tubules separately and the measurement of its specific gravity. In surgery the measurement of function was of paramount importance, because in obstructive conditions, such as enlargement of the prostate, they were able to recognize how near the patient was to the danger point and also the correct time to operate. They could also determine whether the operation should be carried out in one or two stages. The mortality of the operations had thereby been greatly reduced, as Dr. Harry Harris had shown in his paper before the Surgical Section. The mortality of prostatectomy in his hands had been reduced to less than 3%.

In regard to surgical tests of renal function no one test stood out as of superlative merit; few were used out of many. The advantages of the indigo-carmin test were that the renal function could be tested quickly and that there was no need to catheterize the ureters. The disadvantages were that it was not quantitative like some of the other dye tests; only 25% of the dye was excreted by the kidney, the remainder was excreted by other organs.

Rowntree and Geraghty were very enthusiastic concerning the value of the phenol-sulphone-phthalein test, but observations elsewhere had not at first confirmed its accuracy. He had found that an alkaline solution put up in ampoules, as used at the Johns Hopkins Hospital, was absolutely reliable. One cubic centimetre of the dye, if injected intravenously, became evident in the urine drawn by the ureteral catheter within three minutes. If given intramuscularly the dye appeared in from four to six minutes. Specimens were collected at the end of one hour and ten minutes after injection and again at the end of two hours and ten minutes. The normal quantity in the two hours was 80% and he had found this constant and reliable in its results.

The dilution and concentration test was a very simple test and required no special apparatus. It had originated twenty years previously in Vienna. It had fallen into disuse, but during the war it had been revived. He had

used the test for many years and had controlled it by other tests. He had found it extremely reliable. Between 7.30 a.m. and 8 a.m. the patient was given one and a half litres of plain water or water flavoured with weak tea or coffee. No more fluid was given until the test was completed. At 8 a.m. the bladder was emptied by catheter. The urine was collected at 9 a.m., between 9 and 10 a.m. and at 10 and 11 a.m. and each specimen was measured and its specific gravity determined. This covered the period of low specific gravity. Between 11 a.m. and 5 p.m. the urine was collected and measured, but the specific gravity was not determined. This was the transition period from dilution to concentration. The urine was finally collected between 5 p.m. and 6 p.m., between 6 and 7 p.m. and between 7 and 8 p.m., measured and its specific gravity determined. This was the period of high specific gravity or concentration. A normal, healthy man passed the largest amount of urine during the period of greatest dilution between 9 and 10 a.m.; it had a specific gravity of between 1,002 and 1,005. At the period of highest concentration between 7 and 8 p.m. the quantity passed was smallest and the specific gravity rose to between 1,025 and 1,030. The amount of urine passed in the twelve hours was approximately the same as that of the water given. The nearer the patient with an enlarged prostate came to the normal standard, the better would be his chances after operation. If other things were equal a patient who had a difference in dilution and concentration of fifteen points on the urinometer, such as 1,002 to 1,017, might safely be subjected to operation. If the reading of the specific gravity were below this, the danger increased as the difference diminished.

DR. CRAIG said that others would deal with the urea concentration test. It was useful in testing one kidney against the other. The catheter in the ureter might alter the function reflexly. He stated that above everything they should never fail to take into account the clinical condition of the patient. In cases of doubt he would not accept the evidence of the laboratory examination, unless this coincided with clinical observations. For example if anorexia, nausea and loss of weight were present, he would not accept the result of a test apparently showing good function. If the other kidney was shown to be free from pus organisms and gross infection, even if the urine had a low specific gravity and the renal function dye tests were unsatisfactory, he would still give the patient a chance, if the clinical examination were otherwise satisfactory. Sometimes the removal of the diseased kidney resulted in the disappearance of the evidence of inefficiency of the other organ.

DR. S. HARRY HARRIS said that for nearly fifteen years he had consistently though at first empirically employed the indigo-carmin test of renal function. Phenol-sulphone-phthalein and the various polyuria tests had a definite value and at various periods he had employed them in conjunction with the indigo-carmin test. The latest craze, the urea concentration test, was the most liable to fallacy. Complete reliance on its would have led him to disaster on more than one occasion. He could not speak with authority of the estimations of blood urea, uric acid and creatinin and of salivary urea, but perusal of the literature did not warrant the belief that they could supply any information of value to the surgeon that was not more readily forthcoming by simpler methods.

There was no particular merit associated with the performance of a superfluity of tests from the practical point of view of the surgeon. The indigo-carmin test had proved to be both simple and efficient in his hands. The solution

originally recommended for this test by Völcker and Lichtenburg was four cubic centimetres of a 4% solution or suspension of indigo-carmin. He had invariably employed this. It was injected into the substance of the *erector spinae* muscle by a "Record" syringe armed with a hypodermic needle. The normal kidney secreted urine of a dark blue colour within twenty minutes. A patient whose kidneys secreted no indigo-carmin, had urine of a fixed specific gravity; the kidneys acted all the time at high pressure and had no reserve. Any operation on either kidney in these circumstances was inevitably fatal. A kidney whose urine, while not showing a normal indigo-carmin secretion, had a definite blue coloration, was sufficient to maintain life in the absence of its fellow and operation on or removal of the latter might be undertaken. A solitary kidney with good blue secretion would tolerate conservative operation, such as pyelo-lithotomy; failing this, it was best left alone.

In operations on the upper portion of the urinary tract performed during the preceding ten years, when he relied on the results of the indigo-carmin test as an ultimate test of renal function, he had had only two deaths from post-operative uræmia. The one was the death of a patient operated early in the series. The failure of the kidney to secrete the blue had been deliberately ignored. In the other patient the test had by misadventure been omitted. The first patient, a labourer aged thirty-six years, had been admitted to the Lewisham Hospital in August, 1914, on account of recurrent attacks of symptomless hæmaturia on the slightest exertion. X-ray examination had revealed multiple calculi in the right kidney. Pus containing *Bacillus coli communis* had been detected by cystoscopy. There had been a faint green secretion from the right kidney, indicating very defective function. The urine from the left kidney had been sterile and free from pus, but there had been no blue coloration. The patient and his wife had been very insistent on operation, even after the probable outcome had been explained. The operative contra-indication had not then been considered as absolute as they had since known it to be. Despite grave misgivings pyelo-lithotomy had been performed and the patient had died of uræmia ten days later, having suffered from almost complete anuria throughout the period. *Post mortem* examination had disclosed a congenital atrophic cystic kidney the size of a walnut on the left side. This had been the one and only occasion on which he had deliberately operated against the result of the indigo-carmin test. The other death was of a female patient, aged sixty-two years, who had been sent to the Lewisham Hospital in March, 1918, with the diagnosis of a left movable kidney with Dieth's crisis for nephropexy, if thought suitable. She had left the hospital without operation. She had returned six months later and had stated that operation had been advised on the previous occasion after cystoscopic and X-ray examination, but that she had left against advice. Unfortunately her case record had disappeared by accident and the patient's statements had been allowed to carry conviction. Operation had been performed without further examination. On exposure the left kidney had been found to be riddled with calculi and nephrectomy had been performed. By the second day no urine had been secreted. X-ray examination had then shown an enormous dense shadow in the right kidney region. Immediate nephrotomy had disclosed a mere shell of a kidney tensely filled with cream cheese-like pus. Death occurred from uræmia eight days later without any further secretion of urine.

For many years he had made it a practice never to operate, except under the most urgent indications, on

either kidney without knowing the functional capacity of each. In this way only could disasters of that type be avoided. It was a great misfortune that the only instance in which this precaution had been accidentally omitted, should have proved to be one in which it had been most essential.

His experience had already been recounted in detail concerning operations on the lower portion of the urinary tract as exemplified by prostatectomy. He had not had a single death from uræmia after prostatectomy during the previous ten years. Indigo-carmin had been employed throughout this period. He had been in the habit of extending the time limit of blue excretion to thirty minutes when a catheter was retained, as in these circumstances there was always some residue of urine in the bladder which caused dilution of the blue. It was unnecessary for a successful prostatectomy that the indigo-carmin secretion should be quite normal, that was dark blue. Provided that there was a good colour after adequate preparation, renal decompression when indicated being specially important, operation might be undertaken in so far as the renal risk was concerned. It should, however, be borne in mind that renal insufficiency was only one of the risks involved in prostatectomy and that the indigo-carmin and other renal efficiency tests were not of the slightest value in the estimation of general operability. There were very few patients with adequate renal function whom operation would have to be refused on the score of general unfitness.

DR. JULIAN SMITH had learned to place reliance on the indigo-carmin test. He confirmed the opinion of Dr. Gordon Craig that a crippled kidney could be attacked with confidence, if the other kidney responded reasonably to the indigo-carmin test. In addition if the suspected kidney was slow in excreting the dye, for example if in half an hour only a pale grey-green colour appeared, he was led to expect a condition of the kidney which demanded nephrectomy. He had seen enough of the blood urea test to know that it was a valuable indicator in the selection of patients for operation and in the prognosis. With modern guides some patients were excluded from operation so that old statistics dealing with prostatectomy could not be relied on. He agreed that it was not only the condition of the kidney that controlled their ideas of selection, but that of the tissues of the body as a whole. He quoted a case of a woman of sixty with a tumour in the right loin. This patient had developed suppression of urine and concurrently a pain in the left loin. The usual signs of uræmia had been present, namely anorexia, vomiting and some mental dulness. Attempts to catheterize the ureters had failed on each side. There had been an obstruction on the right side twelve centimetres from the orifice and on the left side seven centimetres from the orifice. A trocar had been passed into the right loin and over a litre of blood-stained urine had been evacuated. Later a second attempt had been made to pass a catheter into the right ureter. Clear urine with a urea content of 0.7% had been obtained. The patient had then started to secrete urine and a condition of partial uræmia had ensued over a period of some weeks. The urea content of the blood had been one hundred and eight milligrammes per hundred cubic centimetres; the urea concentration test had yielded unsatisfactory results. He had recognized that there was a double ureteral obstruction and had decided to operate. A double uretero-nephrotomy had been carried at one sitting. The patient had taken the anaesthetic well. The blood had smelt like urine. On the right side he had found an enormous hydronephrosis which had been drained. On the left side there had been

a tense, swollen kidney with large cysts and below a distended ureter in which the cause of the obstruction could not be determined. The patient had stood the operation well. It had taken indigo-carmin two hours to appear from either kidney and at the end of that time the urine had been of pale colour. The urea concentration had not risen above 0.7%. He had finally decided to do no more, because even if he could have dealt with the ureteral obstruction by a plastic operation, the kidneys were too

far destroyed. He raised the question why this patient had done so well. In considering the prognosis in conditions of this kind, it was wise not to be bound to any one test. They should consider what the patient had gone through before, what her family history revealed. She had looked well and had a clear skin. She had been alert in speech and placid in temperament. These were factors that mattered, even though the renal function appeared to be bad.

